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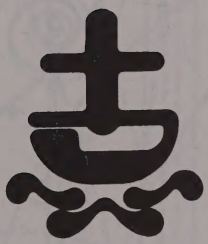
SCIENCE AND THE THEOLOGY OF CREATION

Bossey Seminar

SCIENCE AND THE THEOLOGY OF CREATION



WORLD COUNCIL OF CHURCHES

Sub-Unit on Church and Society

Ecumenical Institute, Bossey

R00397435

SCIENCE AND THE THEOLOGY OF CREATION

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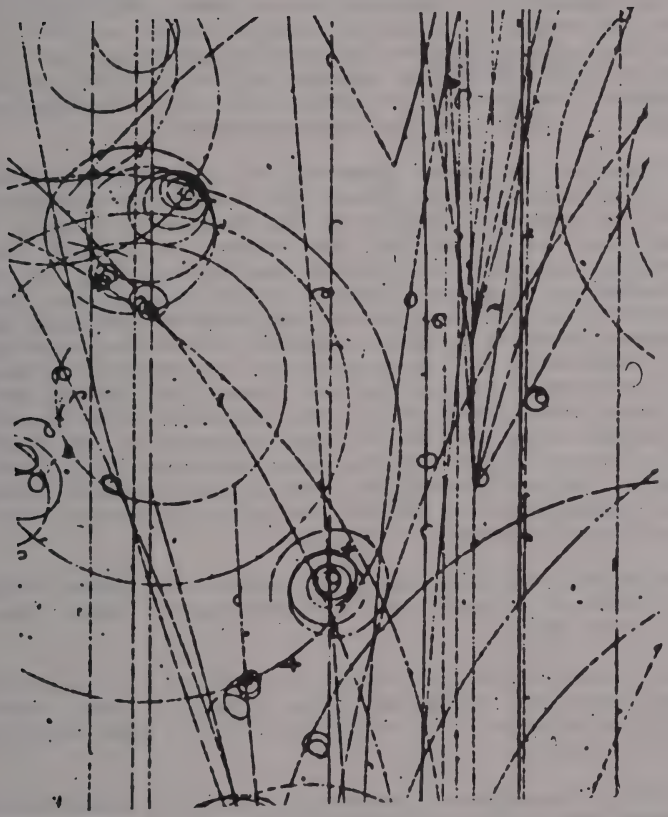
Sub-Unit on Church and Society
Ecumenical Institute, Bossey

Report of a seminar held at the Ecumenical Institute, Bossey

April 12-22, 1988



The material presented does not necessarily represent positions or opinions of the WCC or of its different units or sub-units.

The texts were edited and carefully revised; any remaining errors are the responsibility of the editors.

We welcome ideas, comments and suggestions from readers.

PREFACE

At its Sixth Assembly, the WCC decided that a main programme thrust in the period until the next assembly would be the theme "Justice, Peace and the Integrity of Creation", linking questions of justice and peace with the ecological crisis of our modern world. The concept of creation and integrity has not yet been sufficiently reflected on, especially as the theme for an exploratory discussion between theologians and scientists. Is creation the result of an initial divine action, or is it rather a word signifying an open process for which human beings carry the main responsibility? What theological answers can be given to the questions posed by modern science with its positive and negative impacts on our lives, society as a whole, and the world around us?

This book contains the papers presented at a consultation held at the Ecumenical Institute at (the Château de) Bossey in Switzerland. The consultation was sponsored jointly by the Ecumenical Institute and the sub-unit of Church & Society and was offered as part of the Summer Programme of the Institute. Participants came from all over the world and included theological students, pastors, church headquarters staff, and concerned scientists. The consultation took place between 12-22 April; it included papers presented by guest speakers, discussions, working groups and plenary sessions as well as worship services designed by the groups. There was simultaneous translation into French, English and German. In addition, tours were offered to the WCC headquarters in Geneva and to CERN, the European Organization for Nuclear Research, on the outskirts of Geneva. Here the participants of the consultation left the secure realm of the seminar room and entered the gleaming and mysterious laboratories of science, encountering face to face the people dealing with the issues they had previously discussed in the abstract.

The discussion which followed each major presentation tended to focus on particular recurrent themes which subsequently shaped the final conclusions of the seminar.

The papers presented on the five themes are included in this publication. These papers were all transcribed from tapes, in some cases after translation from their original language, and in all cases were edited by Church & Society staff.

As the staff presentations consisted largely of summarization and commentary upon work already undertaken in the WCC, they are not included in this publication.

The work and reports of the three separate discussion groups were combined and edited by the Rev. G. R. Rajotte to form the final paper "Recommendations for Study and Action".

Following discussion in groups, it was concluded that for science to contribute to the well-being of this planet it must be accessible to all. Not only must scientists be made aware of their responsibilities to society, but it is vital to have a wide range of participation in the process of decision-making, particularly in prioritizing the kinds of research to be undertaken. Both science and theology must be made responsive and responsible to ensure the significant participation of

We wish to express gratitude to all who participated in the seminar and especially the invited speakers. We are extremely grateful to Sheila Ray and Deborah Calame for their administrative assistance, to Dr Gordon Rajotte who compiled and edited the "Recommendations for Study and Action", to Gudrun Smith and Christine Haselbach for their tireless work in transcribing and typing, and to the translation services of the WCC.

Geneva, August 1988

David Gosling Freda Rajotte

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SCIENCE AND THE THEOLOGY OF CREATION
SEMINAR REPORT

Eurig Scandrett

Prior to the sixteenth century, Christian Theology was regarded as providing suitable data, and an adequate paradigm, for scientific thought in the western intellectual tradition. The scientific revolution questioned these assumptions and opened the debate between theology and science, which has continued, often as a power struggle, ever since. Today, our understanding of Science and of Theology, differs from that in the sixteenth century, and the world looks like a different place; hence the debate now takes a different approach.

Addressing this theme within the context of the World Council of Churches' focus on "Justice, Peace and the Integrity of Creation", this seminar brought together some thirty participants, scientists, theologians, clergy and others, from Western Europe, North America, the GDR and several third world countries. Unfortunately, the usual problem of under-representation of people from the third world, of women, and of youth, was present in this meeting. The work of the seminar went on at two levels: in presentations by the speakers and discussions in the working groups.

Addresses

There were five speakers and five members of WCC staff, who spoke on different aspects of the theme. The first speaker, Dr Günter Altner, Professor of Theology and Biology in Heidelberg, spoke on the change in the conception of nature, in the dialogue between theology and science. He focused on two paradoxes in the history of science and their effects on the understanding of nature. Firstly, Darwin's theory of evolution by selection allowed creation to be understood as a historical process in which God participates. This thereby liberates us from a view of God being distant from a static nature. The paradox is that post-Darwinian biology has increasingly attempted to manipulate selection for specific ends, raising considerable ethical problems such as in genetic engineering. Similarly, quantum physics has liberated science from the Newtonian-Cartesian view of the physical world as objective and deterministic, whilst at the same time the splitting of the atom has made possible the development of weapons of unprecedented destructive potential. As a result of these developments, Dr Altner argued that there is a need for science and theology to inform one another, to develop a global science and an ethics of value in biological life.

Rev. Prof. John Polkinghorne, trained in theoretical physics, now a priest, spoke on the unity of truth in science and theology. He argued that science and theology consider the same reality, and as each progresses the truth described by each; experimental truth and revealed truth, tend to converge. A number of aspects of the physcial universe described by modern physics were juxtaposed with appropriate counterparts and derivations in theology. Through this exercise, he developed a 'natural theology' in which science and theology need each other for the purpose of understanding the cosmos.

The subject of God, humanity and nature, was addressed from an African perspective by Dr Jesse Mugambe, a philosopher of religion from Nairobi. Emphasising the importance of a philosophical epistemology for discussing both science and theology, he pointed out that the problem of conflict between science and theology was peculiar to the western intellectual tradition. In the African intellectual tradition, God is not separate from reality, but has a different (transcendent) ontological status within reality. Similarly, each of the other beings (people, animals, ancestral spirits) and things (plants, stones) also have a different ontological status within reality. Thus science, which addresses reality, is unsustainable without faith, in contrast to the western view where faith if often regarded with suspicion by scientists. Dr Mugambe regarded the selective integration of the three world views of the Hebrew creation myth, the Western tradition in which modern science grew up, and the African world view, would provide valuable new insigts in both the scientific and the religious sphere.

Dr David Pullinger, director of the Church of Scotland's Society, Religion and Technology project, gave an address entitled "No integrity of creation without technology". He emphasised that technology is a deeply multi-faceted enterprise. It contains the possibility for liberating or enslaving, opening or limiting alternatives. All the effects of a technology cannot be predicted, but ethical limits to detrimental effects have somehow to be set. Technology is not applied in a vaccuum, but in heterogenous social organisations and an increasingly multicultural world which contains a wide variety of perspectives from which technology will be viewed. Since theology cannot provide an absolute ethic for technology, Dr Pullinger suggested a contextual ethics, informed by theology, which gives meaning and direction to technological decisions. He suggested Ruth Page's Stewardship, Trusteeship and Companionship model as a suitable theological ethic.

Finally, Dr David Trickett, a North American theologian, spoke of some of the insights of A.N. Whitehead's philosophy as developed by the 'process' theologians. Whitehead saw reality as composed of a great network of living relationships between a process of events. The process is not determined, but proceeds to some extent by chance. In process theology, at the depth of these relationships is God, who is the ground of being, and fully participates in the process. God does not determine the process but opens up possibilities, and God is intimately involved in the direction in which creation goes. Thus God is voluntarily limited, and creation is open, but God accepts and is part of the outcome. Dr Trickett explored the implications of this for Christian theology and suggested its potential for dialogue between different faiths and world-views.

Whilst the speakers tended to approach science and theology at a theoretical level there was much consideration of the practice of theology and science by the participants and from the wider experience of WCC staff.

The members of WCC staff drew on other consultations and case studies in which the Council has been involved.

Rev. Fr. Gueorgui Glouchik, an Orthodox theologian from the JPIC programme, posed new questions arising in part out of the recent WCC Consultation in Oslo on the theme "Integrity of Creation". The voices of

individuals and groups such as indigenous populations must be carefully listened to, and the churches must be challenged to most decisive forms of commitment.

The Rev. Dr Freda Rajotte, programme secretary of Church & Society, illustrated the WCC theme with practical examples either based on the recent work of the sub-unit or derived from Lynn T. White's view that the domination of nature associated with the Judaeo-Christian tradition is linked with Caroline Merchant's causative parallel between the exploitation of nature and of women.

Fr. Robert O'Donnell gave an account of Roman Catholic historical perspectives on creation from Augustine, through Thomas Aquinas to Teilhard de Chardin in this century.

Dr Adriaan Geense gave a parallel perspective from within the history of Protestant theology. There was an enthusiastic cross-fertilization and awareness of mutual enrichment between the two approaches, as well as of shared common concern.

Rev. Dr David L. Gosling, director of the Church and Society sub-unit, spoke of the activites in which the sub-unit was involved. These included a study and community action in the Marshall Islands where people are still suffering from cancer and having deformed babies as a result of US nuclear tests, and an educational project in Costa Rica concerning the value of tropical rain forests, which unfortunately are being depleted.

Working groups

The other level of the seminar was the involvement of all participants in working groups in which we discussed the issues raised by speakers and other issues arising from our own experiences, with the aim of producing documents for plenary discussion and publication. These groups tended to address the more practical applications of the theme, and a brief resumé of some of the issues focussed on is given here.

Motives: There was a discussion about what motivates a scientist to do his work, and what other motivations are present in directing scientific research. Concern was felt about the extent to which research was motivated with by profit and financial gain, or by pure inquisitiveness of the scientist or the scientific community. The idea that some scientific research should be done, simply because it can be done, without either ethical constraints or review of human priorities, was considered theologically unacceptable. Also, whilst profit itself may be necessary, the profit as a motive force for research tends to bypass people whose needs ought to be the prime consideration.

Scientism: It is important to be aware that science is a creation of the human mind through observation. Since the observer is intimately involved in the observation, science must not be equated with reality. If science describes the product of human inventiveness, not objective fact as such, then it is relative and cannot be the basis of faith. The extent of scientism in society gave cause for concern as a form of idolatry.

Limitations: The purpose of both science and theology were considered to be the improvement of human well being. Both however are limited in their ability to do so. Modern science and traditional Christian theology are

ideologically tainted by the world view and social milieu in which they developed; white, western, male. This is a limitation, both in the capacity for science and theology for a total understanding, and for their applicability to human need. A corrective measure for this problem would be greater participation of those previously excluded, in scientific and theological activities.

Accessibility: Science cannot be conceived in a vaccuum. Research takes place in a society which is heterogeneous, in which there are rich and poor, powerful and powerless people. The biblical mandate to be on the side of the poor and powerless requires the undertaking of social analysis and questions asked as to who is benefiting from science. History has shown that science tends to benefit the rich and powerful disproportionately, and has often served to marginalise the powerless further. It is theologically vital that the marginalised are involved in decisions concerning science as an essential first step to reverse the process of marginalization.

Image of God: In the biblical tradition, humanity is understood to have been created in 'the image of God'. Thus, God's relationship to humanity provides a valuable model for our relationship with the rest of creation. God loved humanity, became incarnate in Jesus, lived for the outcast, was crucified by the authorities and rose again from the dead. This journey tells us that voluntary limitation, of simple lifestyle, of drawing closer to the exluded, and of restricted resource use are activities which are not negative, but liberate us from our dominating relationship with nature.

The published document will not be the only outcome of this seminar. Participants voiced their support for maintaining contact through the WCC, in order to hear of and support local ecumenical initiatives throughout the world. Another important outcome was the passing of a resolution to be proposed by the WCC to the United Nations. It was suggested that there should be a promise made by recipients of scientific education who are destined to become practising scientists, which is similar in nature to the medical doctors' 'Hippocratic oath'. This should be appropriately worded so that scientists promise not to carry out work which is detrimental to human and/or non-human creation. If the UN were to adopt such a proposal, this whould at least sensitize those who are to practise science, and hopefully result in a shift in the priorities of research.

Criticism of the seminar may be levelled in two contexts - the numerical domination of white, male, anglo-saxon, academics and for the extent to which theoretical rather than practical issues were addressed. However, it is hoped that this document will be read by local Christian groups and scientists throughout the world and stimulate action. As part of the WCC programme, the purpose of these activities is to encourage the commitment of the churches to working for justice, peace and the integrity of creation, from an ecumenical perspective and in a local context. The responses and initiatives of the local churches need to be watched and monitored as an imput for further reflection.

AN INTRODUCTION TO THE SCIENCE AND THEOLOGY OF CREATION

Adriaan Geense

The seminar we begin this afternoon is part of the Council-wide programme on "Justice, Peace and the Integrity of Creation" initiated by the World Council of Churches at its last Assembly in 1983 in Vancouver. You may remember that at that Assembly the Churches of the northern hemisphere were very much concerned with issues of peace that had come to the fore by the planned deployment of medium range nuclear missiles in Europe by the two superpowers. The churches from the southern hemisphere, however, declared themselves to be willing to endorse this issue only if the questions of social and economic justice as the root causes of all possible armed conflicts would be linked with the question of peace. And then both the churches of the northern and the southern hemisphere together discovered that there is a third threat to the survival of humankind to be faced with the same urgency: the ecological crisis that became more and more visible from the mid-1970's. These three main areas of threat would largely determine the agenda of the Council as it formulated its search for unity of the Church in close relation to the renewal of the human community.

The question arose: how to deal properly with these overall problems of humanity inside the reflections and actions of the Council? What would be the Council's specific contribution to these matters of life and death that were recognized by all responsible people in the world, whatever region, nation, culture, religion or ideology they belong to?

It was clear that the specific contribution the WCC could make to these issues depended on the specific responsibility that the churches were feeling as they represented all the different areas of conflict and danger and listened to the same Gospel. They would have to relate their experiences of danger to the specific message of the Gospel if they were to find the right perspectives to deal with these issues. This meant that apart from an analysis of the situation, they would have to find common theological perspectives and categories to express specific Christian responsibility. In relation to the social and economic questions and in relation to the questions of war and peace, the Council already had developed a strong tradition of reflection in its nearly 40 years of existence. Reflections on questions of ecology started much more recently. Moreover, for the first two areas the words "justice" and "peace" already carried a biblical and theological connotation making them appropriate to express the specific Christian concern.

What about the ecological area however? How could that be theologically conceptualized and categorized so that the churches would recognize it and become involved in it? After some discussion, this area of concern and responsibility was called "Integrity of Creation", replacing or reformulating the pre-Vancouver concept of a "sustainable" society. Giving a name to a child is one thing, knowing what it means is another. What do we mean by "integrity of creation" next to "justice and peace"?

If the idea behind the formula indicates not only an area of concern but also a perspective, a hope and an ideal in the same way that "justice" and "peace" are concepts loaded with biblical promise, then we should be able to develop this concept in such a way that it becomes an instrument to motivate action and reflection. Moreover, it should be recognizable by those outside the realm of the churches who have taken up the ecological question. "JPIC" should not only be an instrument to help achieve unity between the churches but also have the capacity to formulate the dynamic perspectives to achieve the unity and renewal of humankind.

It is in this sense that our Ecumenical Institute at Bossey, together with the sub-unit Church & Society, has taken up this question in its programme this year. It is, however, not the only sub-unit of the Council to consider this theme. Church & Society organized an informal brainstorming session last year in Amsterdam, of which you have received the report: "Reintegrating God's Creation". Faith & Order dealt with the question in a meeting in Porto Allegro, Brazil, in November last year; the JPIC programme was responsible for an intensive consultation in Oslo in February/March this year; and the Orthodox churches organized a study encounter in Sofia last autumn.

As the JPIC process is council-wide, and as there are many aspects all these meetings reinforce each other and may at the end be a help to the churches as they prepare to become involved in this process. It is a good thing that in as many places as possible people meet to discuss these questions.

Therefore, without claiming a monopoly on this process, our Ecumenical Institute tries to deal with the issue of the integrity of creation in a specific way. I will now describe the main characteristics that have moulded the building up of our programme and the composition of the seminar.

The composition of the programme and the selection of speakers and participants will enable us to look at the 'ecumenical' aspect in the twofold sense of the word. The word 'ecumenical', on the one hand, aims at bringing churches together and as such it belongs to the classical mandate of the WCC. But the word 'ecumenical' can also be used in a wider sense: to make a deliberate effort to bring perspectives together that tend to be isolated and absolute.

Ecumenical discussions conceived in this way are not only directed towards the perspective of unity of the churches and humankind but also to the unity of truth that is the last eschatological perspective behind all forms of the search for truth in philosophy and search for knowledge in our scientific world. The search for the unity of truth is, so to speak, on the level of reflection parallel to the search for unity of the church on the level of action in the ecumenical movement. The discussion on the relation of theology to science, aimed at the unity of truth, is the necessary counterpart to the discussion on the relation of the church to the world, in which the ecumenical movement searches for the unity of the churches.

But now you may ask: the unity of truth as a parallel or counterpart to the unity of the church and the unity of the church and world: are these

not too large, abstract, idealistic and therefore unworkable concepts?

Do we already have sufficient clarity of what we mean by the unity of the church or the relation of the church to the world to enable us to draw up a parallel with the unity of truth that will make any sense?

Was this not the experience of the World Council itself as it searched many years for the unity of the church without having a clear understanding of what it was searching for, i.e. without a clear sense of direction? Should only one specific concept of the unity of the church have been normative at the beginning, the Council would not have been able to start its work, as it would have excluded other concepts. In fact the World Council, during its 40 years of existence, discovered that it had to develop the discussion about the concept of the unity of the church parallel to its activities of bringing the churches together in their life and work.

It is the same way with the coexistence of all branches and disciplines of scientific endeavour inside or outside the university, where it is impossible yet to speak about one concept of truth that would govern and direct this coexistence. The medieval concept of the unity of truth in the synthesis of nature and supernature that governed the existing universities has definitely broken apart in the process that led, through the Renaissance, Reformation and Enlightenment, to the founding of the modern universities. These universities now organize the unity of their activities on a purely pragmatic basis and no longer on a spiritual or ideological basis. If we are looking for the unity of truth, then the concept of it can be developed and clarified not at the beginning but only in the course of the investigations and the search for consensus. In other words, the idea or concept of the unity of truth can be our guiding star only if it is conceived as an eschatological concept, a final vision.

On the way towards that final, eschatological vision of the unity of truth, however, the Christian churches that give account of their hope in the development of their theology can perhaps formulate some guidelines as basic conditions for this unity that we seek. We have put them as the basis of our deliberations in this seminar and we want to discuss them briefly.

In the search for clarification of the concept "integrity of creation" and for a theology of creation, we cannot accept a final dichotomy between theology and science. Those who plead for a division of labour and against the mixing of the categories between the disciplines of theology and science, as for example Karl Barth, have not done so out of a desire to isolate theology in a storm-free zone of orthodoxy, as it is often interpreted, but out of the desire to better equip the partners of the discussion.

In the encounter between theology and the world of science, not only one discipline or specialization of science (i.e. physics) should be the partner of the discussion, but all relevant disciplines and all interdisciplinary projects: physics (classical and nuclear), biology (with genetics), chemistry, biochemistry, ecology, etc. Only the bringing together of these disciplines from their specific perspectives can keep them from absolutizing both their methodologies and their results.

The same methodological principle on the side of theology means that we should not allow a dichotomy between the different disciplines of theology: exegetical, historical, systematical and practical, or between the different topics of theology and, for the sake of discussion, choose arbitrarily between a theology of creation, a theology of exodus, a theology of reconciliation, a theology of liberation, etc. If sometimes we focus on a special realm of attention, it does not mean that these realms can be absolutized as the total perspective into which the whole of theology has to be integrated.

Applied to the theme that interests us most in this seminar, we are aware that speaking about creation and not about nature implies that we cannot conceive speaking about creation without speaking about a creator whom we confess to be not a sort of demiourgos (a first principle) but the God and Father of our Lord Jesus Christ.

In the discussion on theology of creation and the integrity of creation, the perspective of only one culture (i.e. the northern scientific-technological culture) will not be permitted to speak on behalf of all cultures, regions and contexts: every culture and context shall speak for itself on the basis of its own tradition. This is even more imperative as many people hold the northern scientific-technological culture, with its marked domination of nature, responsible for the exploitation of the natural resources and, therefore, for the global ecological crisis, for the benefit of one culture. The Cartesian separation between the thinking subject and the dominated objective world will have to make place for a more participatory style of thinking and action. For the practice of a more participatory style of reflection, the wisdom of other cultures, especially from Asia and Africa, will have to be integrated into our discussions.

The encounter between the different cultural perspectives that shape our attitude towards nature cannot leave aside the respective positions of the different living religions and ideologies that shape a culture. At the same time we should be aware that many forms of integrated wholistic thinking, as soon as they express themselves religiously, tend to be some kind of monism or pantheism, that does not take into account the distinction between the creator and the creation that is characteristic for the biblical tradition.

Our seminar is a seminar that is open to all those who are interested in a further exploration of the concept of "integrity of creation" and in the relation of theology and science. But not all of us are experts in this field as are our speakers and some of our participants. The relation between those who are experts and those who are not, however, is not the relation of those who teach to those who are taught. All our participants, whether experts or not, are resource persons. That is a fundamental rule in all our Bossey seminars. Not only the perspectives of the scientifically trained partners in the discussion are important; the experiences of "ordinary people" - non-experts often contain valuable insights that tend to be overlooked in more abstract approaches. Abstract, scientific approaches have been derived from experience and experiment but often have difficulties in relating back to daily and culturally diverse experience.

Our attempts at inclusive, participatory thinking mean also that not only the perspectives of the predominately male partners in our discussion are valid. They should be balanced by an input from women's experiences and women's perspectives. This was made clear in the Norway consultation last month on the same subject, and we want to underline this with a contribution from a woman staff member of Church & Society who participated at Oslo.

Finally - last but not least - we will have to overcome the dichotomy between "theory" and "practice", between "faith" and "action". There is always a danger that discussions about theology and science remain in a theoretical realm and deal with abstract world conceptions, more or less motivated by apologetic purposes. I hope that in our seminar it will become increasingly clear that the very isolation of theoretical reason from practical responsibility is one of the root causes of our today's impasse. Scientists become increasingly open for encounter with theological perspectives, not because they need them for their theories but because they discover the responsibility for the consequences of their theoretical investigations. It is in this context a fascinating problem whether this will lead scientists to a voluntary limitation in the use of reason or whether the fields of exploration in "nature" remain in principle free and endless and whether the responsibility of the scientist begins only after he or she has made the theoretical discoveries. Both in the field of nuclear physics and in genetic engineering these questions have come to the forefront. Are there theoretical limits in our explorations that we should not transgress and if we do, do we become a transgressor against our creator? And, on the other hand, are there healing insights in our theoretical investigations that should not be left on the level of academic theory but be transformed into practical and political action?

The World Council of Churches is neither a university nor a research institution. If it seeks the insights of the scientists it is because it wants the conscience of world Christianity to be sharpened for its global responsibility: global not only in its geographical sense, but in the sense of extension to all realms of science that determine our present world.

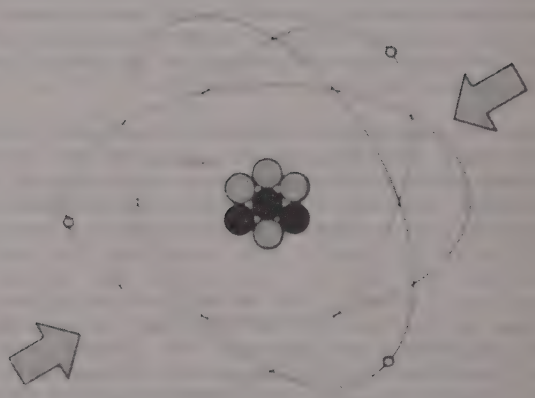
We should not have the illusion that we will solve in ten days all the questions that come on the table as we begin our discussions on theology of creation, integrity of creation, and the relation of science and theology. We will not reach perennial results. We can only for our part and together with many others in other places and on other occasions, sharpen our awareness and responsibility in the conformation with the insights of others in other scientific and cultural conditions.

But we hope that we on our part and as "pars pro toto" will discover something of the implications of ecumenical thinking, understood as inclusive thinking: inclusive in scientific perspectives, inclusive in theological perspectives, inclusive in cultural perspectives, inclusive in the integration of the wisdom that is hidden in other religions, inclusive in the community of lay and experts, of men and women, of theory and practice.

It is our conviction that only by keeping to these conditions can we

avoid dichotomy, sectarian scientific thinking and sectarian theology that all tend to isolate and absolutize one or another perspective. Only by keeping to these conditions is there a promise of a deeper understanding of the relation and interdependence of such abstract concepts as justice, peace and integrity of creation.

All the concepts of the unity of truth between theology and the other sciences that we will discuss in our seminar will have to pass this ecumenical test. Let us do our work and let us have our discussions as a community, a community of scientists and believers, a community of churches and of cultures, young and old, experts and interested lay, men and women. Let us not withhold ourselves or hesitate to make a contribution. Let us all share our insights and our ignorance. Let us recognize how fruitful our encounter can be, not only for our theoretical insights, but for the practice of our life and faith.



THEOLOGY AND NATURAL SCIENCE: THE DEBATE TODAY

Günter Altner

As Rolf Kreibich puts it, we are living in a scientific, high-technology society. Such a society is characterized by a dynamic inter-linking of science, the development of technology and the interests of capital - a process which is also becoming more decidedly an element in the industrial and military sectors. It is a society which is being increasingly conditioned by the momentum of progress in science and technology. It may indeed be true that the interests of capital for their part also have a dynamic that cannot be ignored, but the independent momentum of progress in scientific and technological knowledge is a concomitant factor which must not be underestimated. The conditions of life are changed by this momentum, not only in the industrialized countries but throughout the world. Nuclear technology, chemical technology, space technology and biotechnology link up in many different ways. And they are affecting the shape of progress too because of their penetration of the armaments sector.

In describing this whole system we cannot fail to point out that its progress represents a constellation of factors which does not simply give birth to a new scientific scenario but affects in a variety of ways the conditions of life on earth which have so far existed. Since the early 1970's there have been repeated attempts at global analyses - balance-sheets of crisis. These analyses show up the reverse side of the medal: the dismal image associated with the science and high-technology society. Carl Friedrich von Weizsäcker in his publications has repeatedly spoken of the road that runs straight as a die from Galileo to the atom bomb. It is not just the ruthlessness of vested interests that makes science and technology dangerous and destructive. The problem more deeply underlying modern progress lies in the methods of research themselves, and in the technological possibilities unleashed by these. Therefore, the present debate between theology and natural science is not just theoretical. Technical civilisation and life on earth are on a collision course directly related to the question of the appropriateness of scientific and technological reason, and its limits and results. For this current debate between the two, however, the interest lies in the question of historical roots: how could it come about that this momentum of progress now threatening to engulf us arose directly out of the history of Christianity in Europe?

In our present context two historical factors should be kept in mind:

1. The dynamic of salvation history in the Jewish and Christian traditions has undoubtedly played a part in producing that unrestrained focus on the future which marks progress at the present time. That thesis goes back at least to Karl Löwith. The dynamic of biblical salvation history, the related distinction between the old and the new creation and the eschatological expectation of the coming Kingdom of God in the New Testament penetrated deeply into European history. And even where general secularization is taken for granted and we have to start with completely immanent ideas of progress and perfectionist hopes on the part of human beings, the traditional Jewish Christian inheritance has had an impact.

It should also be emphasized that in relation to this great revolutionary switch from the eschatological hope of salvation to human self-fulfilment, nature as something created along with humanity and as a precondition for human life came to grief, becoming the material used to shape human and social progress.

Attention must be drawn here to a second theological source.

2. Genesis 1:28 and the dominium terrae it implies are at present much discussed: in the evolution of Europe they have had a constant influence beneath the surface and this has still never been investigated. The arches of the bridge between then and now have of course collapsed but even the piers are difficult to trace. This is the context in which the corporeality of human beings and nature in general were lost to view among Christian hopes of salvation at an early date. Undoubtedly Genesis 1:28 is present in the monastic ora et labora and what resulted for agriculture from this attitude. It is interesting too that Hugo de St Victor, the scholastic theologian, was prompted by medieval mill technology to speak of the hope that physical and technological knowledge could once again make practicable what sin had distorted: the dominion mentioned as a command in Genesis 1:28. There is doubtless a chain of thought starting here and stretching to René Descartes and Francis Bacon who called for the mastery of nature on the basis of mathematical skill. And was it not Bacon who saw nature becoming a warehouse for man the technician in this way?!

The extent of developments in this to date is revealed not least in genetic and biological engineering. These are encroaching on those who have exercised that mastery and subjecting them in their turn to the practical application of objectifying reason. Having failed in defending their positions against Galileo and Darwin, theology and the Church have handed nature over to scientific research. Nature no longer seemed relevant to Christian hopes of salvation, except among those outsiders in physics and theology and in the Church's hymnology who clung to the beauty of nature as creation and also made this the source of rules of conduct. But they were on the periphery. They were exceptions.

The question as to the limits of scientific rational thought in principle - its presuppositions and its consequences - was critical, and theology's true task would have been to broach it in debate with natural science in its headlong onward march. But to a great extent the question was never asked. Hence nature was prematurely abandoned by western theology where there should always have been action here for the benefit of nature as creation, remembering that its salvation is also meant to be perfected.

Nevertheless there is at present in our scientific and technological society a desire for discussion between theology and the natural sciences. This desire comes from both sides. It has to do with the crisis threatening the whole of nature on earth and the knowledge that nature has an intrinsic value and is not just a cluster of objects. In the manifesto of 'Austrian Scientists for Environmental Protection' (Oesterreichische Wissenschaftler für den Umweltschutz) it is said that 'every form of life is unique and must be respected independently of the practical value it has at the moment for human beings, and it must be preserved from thoughtless destruction as a basic service to

This Austrian voice must be included in an intensive philosophical and theological discussion on the intrinsic worth of nature:

- On the occasion of the jubilee gathering of the firm of Hoechst/Frankfurt Hans Jonas the philosopher was able to call for 'dread of the holy' as a primordial basic attitude in human beings of today: 'We shall have to re-learn fear and trembling and, even without God, the dread of the holy'.

- In this appeal Jonas is aiming at a general reverence for life such as Albert Schweitzer had formulated at the beginning of this century and is remembered by many today: 'I am life desirous of living in the midst of life which also desires to live'.

- Taking his cue from Kant, Klaus M. Meyer-Abich coined the phrase 'Peace with nature' and this too has as its aim a relationship between human beings and nature which can be described as a community of responsibilities: 'Human beings, animals, plants and the elements are related in natural history and they constitute nature's comity of law...The intrinsic worth of the natural world in which human beings live is expressed by them in the form of rights.'

- Finally Jürgen Dahl, whose stance is unambiguously agnostic, has expressed what many concerned people are thinking today: 'In dealing with everything which represents the incomprehensibility of this world - with living creatures and genes, with the basic components of materials and with the forces and laws of matter, agnostics would want the greatest caution to prevail.'

- Stock-taking in the theology of creation has made an impact in the Christian churches over the last decade as an ecumenical process of rethinking. It is on the same wavelength as these general reflections which have helped to reassert the intrinsic worth of nature. The oikonomia (stewardship) which Gen.1:28 calls for is, not least, understood as loving care and protection in the tension between tilling the garden of Eden and keeping it (maintaining its 'integrity'!)(Gen. 2:15). But God's becoming flesh, to which the New Testament testifies, is also understood here as a radical intervention by the Creator in the development of the world of creatures which is his.

There can be no question that the discussion of pantheism which has been made taboo by western theology again becomes topical here. But at the same time this process of rethinking is, significantly enough, taking place subject to the demand for a radically intensified ethical commitment. We are witnessing an ethical revolution that is embracing wide circles of society. In it the intrinsic worth of nature can be discerned over and beyond human and social ideals and demands commitment. Essentially there are always three stages in this - backed up by an impressive variety of reasons:

1. People become aware of nature when brought up sharply against a crisis, just as they previously became aware that slaves and women and exploited workers (and today the Turks) are fellow human beings.

2. Through this their humanity changes. It becomes deeper. When they see nature threatened human beings come to see it as akin to themselves.

3. This makes them able to be reconciled with nature, overcoming alienation and developing new forms of cooperation and co-production.

It is not a matter of assimilation to nature, of naturalism, of some 'back to nature' romanticism, but of discovering and following through in practice what is common to human beings and nature. There has to be a new, deliberate, socially and ecologically sustainable metabolic exchange with nature. When we describe the results of the ethical revolution in this way, the depths of the contrast that characterizes the world of today also becomes apparent. Despite all the reflection and conscientizing in the interests of nature and despite all promulgations of national and international policies for the environment, the process of destroying nature on this earth goes on more unrestrained than ever in human history. Air, soil, water, flora and fauna and indeed even the conditions that affect the world's climate as a whole are being destabilized because of pressures of technological and industrial activities such as are typical of our scientific, high-technology society.

Turning to the discussions between theology and physics, here too the outcome of our analysis will be a description of the same paradoxical set of circumstances. Over against a radically deepened understanding of nature stands an instrument for dominion in the shape of nuclear technology which, if human beings misuse it, can bring about the end of human existence and all higher life on earth.

Looking back into the nineteenth century we find mechanistic physics putting forward its world view. According to the premises behind the research of that period the world was a machine, running on eternally and unchangeably. Everything was traced back ultimately to motive forces. And so the combining of atoms was also seen as the unalterable interplay of eternal driving forces. On the occasion of the Innsbruck Conference of Natural Scientists in 1869 Hermann von Helmholtz, the doctor and physicist, reduced it to this: 'If movement is the original change which lies behind all other changes in the world, then all elementary forces are motive forces and the ultimate aim of the natural sciences is to discover the movements, and the forces that drive them, behind all other changes - in other words, the sciences are reduced to mechanics.

Although this paradigm of mechanistic physics was very soon overtaken by further theoretical approaches it lasted on into the twenties of our century, till the determinism of classical physics was shattered by the quantum theory revolution (Bohr, Heisenberg etc.). At the turn of the century it had been discovered in quantum physics that the atomic particles did not behave at all like large bodies, and - like the planets - circled in orbit. Depending on how experiments were conducted they revealed themselves as a wave or a particle. No clear-cut prediction of their future behaviour could be found. The determinism of classical physics dissolved into a calculable field of possibilities. Hans Peter Dürr has described as follows the situation arising from these findings: 'This simple picture of reality has undergone a critical change. The decisive turning-point came about as a result of quantum mechanics. Though previously it had been necessary to dispense with absolutely

precise statements and, in particular, predictions, and be content with stating probabilities, it now turned out that the probability characterizing statements in physics does not derive simply from subjective ignorance but inheres in the natural event itself. No matter how exactly all the facts are observed at the moment, this will as a matter of principle not be enough to predict what will happen in the future, but only opens up a particular field of possibilities for the realization of which certain probabilities are indicated. Thus the future event is no longer determined or fixed but is in a certain way open. This means that the natural event is no longer some clockwork mechanism but has the character of a continuous development. The act of creation has not been concluded - at every moment the world is coming into being afresh.

With this the old Cartesian picture of humanity as lord and master of nature collapses. Given the cluster of experiences described by Dürr, natural scientists are observers who are themselves involved in nature. This ties up completely with the introduction of the ethical dimension into humanity's relation with nature which we earlier described. But it would be wholly wrong if we entertained the hope that modern physics had produced a soft technology in the train of the quantum theory. The classical technology of exploitation can still be operated in the traditional way where so many nuclear processes overlap and can be technologically focussed and controlled. The development of nuclear technology - first for bombs and then derivatively for 'the peaceful uses of nuclear energy' - is in a sense classical technology based theoretically on a quite different kind of complementary physics. This is the paradox of the nuclear age, reflected not least in the minds of the physicists.

The developments of quantum physics may be fêted as the product of an international scientific effort, but under the pressures of the second world war the technology of the atom bomb led to a division of the community of physicists, with some working on the construction of the bomb in one place and some in another. This demanded wholly new kinds of high technology as events in the USA showed. But political thinking changed too. The possibilities of nuclear bomb technology formed the basis for the strategy of deterrence and those physicists who to begin with had led the way in knowledge and ideas became with their know-how hopelessly politically dependent and still have not been able to free themselves from this dependence, though repeatedly coming forward as spokesmen for new destructive capacity. On the contrary, since the development of the atomic bomb, research in armaments has undergone constant expansion, thus penetrating into increasingly extensive areas of science and the economy.

Turning now to modern biology, we find ourselves confronted with a similar kind of paradox to that which we found in physics. Theoretical discussion on evolution as something occurring as an open process of development in time implies recognition of the non-objectifiable quality of living nature. But a new dimension of technical manipulation of nature is opening up with the changes made possible by biotechnology and the programmes of production it replaces. This new dimension is far removed from that sensitivity which is required in the discussion of the theory of open systems in living nature.

It began with Charles Darwin. When in 1859 he published his book on the origin of species he introduced the dimension of time into scientific biology and many of his scientific contemporaries failed to see this. The theory of evolution states in fact that nature has a history and that the historical nature of this process is documented by the successive emergence of constantly new forms of organization. Thus there is a clear collocation in time which cannot be repeated even once. In his theory of selection too, where he sought an immanent explanation of evolution, pointing to heredity and selection, Darwin takes account of the temporal element in the process of evolution. And by this he means that in principle the constellation of events working together at any given time cannot be predicted but can at most be characterized by statements of probability.

In alluding to chance and the probability of events which it shapes Charles Darwin had no intention of developing a polemic against the idea of the teleological providence of God as this was conceived in the 19th century. By referring to chance Charles Darwin rather shows his modesty - the scientist's inability to predict deterministically the process of evolution. Even if he does not use this concept he does give expression in his theory to the recognition that evolution is a process in time and does not repeat itself in the way it has already occurred.

We can see not least in Ernst Haeckel, his most zealous disciple and apologist, how little Charles Darwin was understood by his contemporaries. Haeckel thought wholly in terms of mechanistic physics and saw the world even in its evolutionary development as a machine. He wrote: 'As a comprehensive philosophical world view the general theory of evolution assumes that throughout nature a great, unitary, uninterrupted and eternal process of development is taking place, and that without exception all natural phenomena - from the movement of the heavenly bodies and the falling of a rolling stone to the growth of plants and the human consciousness - occur in accordance with one and the same great causal law, and that in the end everything is to be traced to the mechanics of the atoms: a mechanical or mechanistic, unitary or monistic world view - in a word, monism.'

It is not without irony that in the name of mechanistic physics Ernst Haeckel in defending the idea of evolution draws here on biology to complement that dimension of time which Darwin introduced. From the movement of atoms through to human society there is only the mechanism of the general struggle for existence. In comparison with this dismal interpretation, which lasted in biological thinking into the middle of this century, the current discussion on the open system theory represents progress. Here we have to consider how we can describe the conditions for possible new openings in the evolutionary process in the direction of new forms of metabolic organization.
Today's theorists in modern biology look on the process of evolution as an open, self-transcending process of becoming, constantly generating a cascade of new classes and qualities of survival systems by way of quanta, molecules, DNA protein cycles, achievements in reproduction, stimulation processes and social characteristics. In this connection Konrad Lorenz speaks of Fulgurationen ('lightning flashes'). By this he means that new realities are repeatedly opening up in the hierarchical structure of the cosmos and of what is alive in the cosmos - given the prevailing conditions at any given time and the chance components within them.

From this standpoint we cannot talk as if there were a universal law of evolution to be deduced from the alignment of its basic blocks of masonry and the forces operating between them. No, evolution is creative and itself has a capacity for evolving. It is a groping, unpredictable process, weaving the tumultuous forces at work in it into constantly new arrangements. Rupert Riedl the Viennese zoologist virtually hymns a eulogy of this phenomenon of qualitative, self-transcending revolutions. He says: 'Evolution erected from the Animal the vertebrate, the mammal, the primate and finally man, and on man has built friendship and community, mind and civilization. By lowering the status of what is inferior it has constantly created greater differentiae - order, predictability, harmony - where previously there was no hint of these.' On our subject Erich Jantsch, the physicist, talks about the self-transcendence of the evolutonary process on every level, and Ilya Progogine had already described this phenomenon in relation to the dynamic states of non-living matter.

It should not be forgotten that already in the 1920's Teilhard de Chardin interpreted evolution as a creative process, thus directly hinting too at the phenomenon of temporality such as Darwin had in mind.

> What an expansion! This jump into what was thought improbable... Is this not exactly what we could expect based on our theory? The explosion of inner energy as a consequence and proportionate expression of total over-organization of matter?... Evolution should be nothing but a theory, a system, a hypothesis? Far from that! It is much more! It is the general condition which all future theories, all future hypotheses and all future systems will have to take into account... A light which enlightens all facts, a curve which all lines must follow: this is evolution.
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> (C & S staff translation)

We find something like a late echo of this dynamic view from the twenties with Jürgen Moltmann in his ecological doctrine of creation, now likewise following as a pattern of thought the idea of immanent transcendence:

> In the free, outflowing rapture of his love the eternal God goes out of himself and makes a creation, a reality, which is there as he is there, and yet is different from himself. Through the Son, God creates, reconciles and redeems his creation. In the power of the Spirit, God is himself present in his creation - present in his reconciliation and his redemption of that creation.
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> J. Moltmann, God in Creation,
> SCM Press Ltd, 1985, p. 15

Quite clearly biology and the theology of creation today can talk almost the same language, given thinking which accepts the idea of process. Always of course there is the question right across the board how we can detail and describe the conditions for this process which repeatedly opens itself up afresh. Is it simply a matter of self-organization or does evolution in itself repeatedly need an opening, the underlying causes of which cannot be derived from itself? However we may answer this question, thinking in modern biology goes far beyond that old mechanistic attempt at interpretation such as was usual in Haeckel's day. That makes

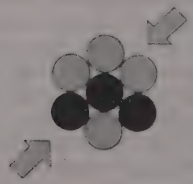
it all the more surprising that in its way of manipulating life on the basis of hereditary structure modern molecular biology is lagging far behind what theory is claiming for open systems. In a sensee it is mechanistic biology based on the structures of DNA and protein and is always tempted to constrict through one-sided action the openness of the evolutionary process and create a dangerous bias in the approach to the overall course of evolution. This skill in manipulation is finally extending its range to human beings. Since Descartes they have appeared to be detached from nature as the res cogitans (thinking [and knowing] subject). Now they are themselves becoming res extensa (an object) because of objectifying technology.
Given these problems, what is the task in the debate between theology and the natural sciences? Let us summarize in a few points the conclusions that must be taken into account:

1. The theoretical discussion between theology and science is also of necessity practical. It involves investigating the ravishing of life on earth through the uninhibited progress of objectification in the process of scientific research. Although physics and biology have got beyond mechanistic thinking and have rediscovered the factor of time in the general process of becoming, the technologies they have produced (nuclear and genetic technology) are an objectifying manipulation of nature in the classical sense. This problem needs clarification.

2. In view of the extent to which destruction has proceeded, the task to which both partners must be committed is the endeavour to preserve the integrity of creation on earth. Here the starting point has to be the biosphere as the basic, fundamental unit in life. All efforts in regard to the environment and the politics of development and peace have their authentic basis here. We can ask about the wholeness of nature only in relation to the earth as the one world in which we can live.

3. Preserving the integrity of creation on earth must therefore always include striving for justice and peace. But it would be wrong to build on the idea that technological and industrial progress in the service of peace and justice has lost its capacity for endangering life on earth. Modern technology is epitomized by a blindness which must be replaced by a symbiosis in the shape of a kind of general metabolic exchange between humanity and nature.

Translated from the German
Language Service, WCC



THE UNITY OF TRUTH IN SCIENCE AND THEOLOGY

John Polkinghorne

I very much value the privilege of being able to talk with you this morning and later on to have a conversation as our discussion progresses. I believe very strongly indeed passionately in the unity of knowledge and the unity of truth. And I think at least in the western world that unity is under threat at the moment. Its under threat because the great successes of science, the way in which science is able actually to settle questions to universal satisfaction, has encouraged a division of knowledge into a public domain which is thought to be concerned with agreed facts and which is handed over to science; and a private domain of value where there is not universal agreement and where religion and many other forms of human activity are to find their place. If that division is accepted then we have divided knowledge up into the scientific, which is true, and other forms of knowledge - including religious knowledge - of which one could only say is true for me. And I think that would be a disastrous division to make. Further, I think that theology has to resist a truth with science on those capitulatory terms. I believe in the unity of knowledge, I believe that we have to hold together all the experience and insight that we gather about this remarkably varied and complicated and fascinating world in which we live, and I believe that that quest for the unity of knowledge is for us underwritten by our belief in the one God who is indeed the creator of all that is and the ground therefore of all of our knowledge and experience.

It is part of the cumulative case for theism, part of the attraction of believing in God, that we are provided with that round of unity so that for example that rational order in the world which science discerns is perceived as a pale reflection of the reason of the creator. Our experience of beauty - which seems to me is a fundamental human experience, not just a epiphenomenon, not just a bout of emotion, but something really true and of the greatest significance - is perceived as our sharing in the joy of the creator in his creation. Those ethical imperatives of which we have experience are perceived as intuitions of God's will and of course of our religious experience - that experience of union and that experience of judgement and mercy - are perceived as intuitions of his presence. Belief in God is an integrating belief that holds together those diverse aspects of human experience. And if that is true, then science and theology are bound together, they need each other. And we have to ask ourselves in what way do they relate to each other? How do they interact with each other? In addressing that question I want to say two things about science.

The first thing I want to say is that I believe that science is complete in its own domain. It does not need theological augmentation for its own inquiry. I think we have every reason to believe that scientifically posable questions are scientifically answerable. Of course they are often extremely difficult to answer, but I don't think we have reason to think that we need to go outside science to find the answers to them. In other words I am setting aside that one God who is really dead and of who's demise no-one should be regretful, the God of the gaps. We have learned I think, and wisely learned, not to make statements like "Only God could

bring about the emergence of life from inanimate matter". We don't understand of course very much about how life evolved yet, the biochemical pathways are largely hidden from us, but I think we have no reason whatsoever to suppose that the emergence of life on earth did not take place according to scientifically describable and scientifically comprehensible ways of proceeding. So in its own domain science is complete.

But in another sense science is woefully incomplete. Science achieves its very striking success by the modesty of its ambition. It is a strictly limited form of inquiry. Science is concerned with what is general, with what is impersonal and very largely with what is repeatable. I know of course that there are sciences which are not repeatable, cosmology is an example, but the observable sciences like cosmology and evolutionary biology depend very critically for their explanatory power upon the insights of the experimental sciences - such as physics and genetics. Science is, therefore, addressing a limited set of questions about the world and it seeks to answer those questions by using a limited set of methods which I have characterised as being impersonal inquiry. And I think the two most important things there are that science by and large proceeds by testing.

I am a theoretical physicist by profession, I worked with pencil and paper, but I would gladly acknowledge the important and indeed essential and leading role played in my subject by my experimental colleagues, many of them up the road at CERN which you are going to visit. Science gains its power to settle questions to universal satisfaction by its power to put things to the test: to express its expectation - that is to say to make predictions - and then to engineer circumstances in which one can see whether those predictions are indeed fulfilled.

Now there are many realms of inquiry and of experience in which the power of testing and the power of prediction do not exist. All those forms of personal encounter between ourselves and of course even more so with God himself, those forms of personal encounter are necessarily based not upon testing but upon trust. If I am always setting little traps to see if you are my friend: you know I'm today wearing a Trinity Hall tie and I wonder whether you're going to say to me "John that's a nice tie you're wearing, what does it mean?" I'm offended if you don't ask me. If I set little tests to find out whether you are my friend I shall destroy the possibility of friendship between us. Similarly, personal encounter is not subject to prediction, it is only in the encounter itself that the meaning will be found.

Therefore, a part of science's limitation, as well as its strength, is its dependence upon the experimental method and by and large - and this is of course particularly true of the science in which I worked, which was elementary particle physics, - science learns a lot by picking things apart to find out what they are made of. Now you can learn a lot of valuable and interesting things that way but there are also a lot of things that you cannot learn that way. If you take some splendid painting - a Rembrandt self-portrait let us say - and you ask a scientist as a scientist to tell you all he can about that painting, he will be able to tell you the chemical composition of every spot of paint in the picture and he will be able to log the position of each spot of paint. And having

done that he will have done all that he can as a scientist and in his own terms he will have given you a perfectly complete description of that painting. If you take the painting apart that is all you will find. You will not find the spirit of art or beauty among the residue, but if you think that a Rembrandt self portrait is a collection of spots of paint you have missed the point of the picture. So science is limited in those ways, and because it is limited in those ways, though it is powerful and capable of answering its own questions, it also leaves many questions unasked and therefore unanswered.

There are of course questions of meaning and purpose about the world, questions that we have to ask as human beings about the world - and indeed science even leaves unanswered - questions which arise from science itself but which are not scientific in character and, therefore, which it is incapable of answering. To give you an example of one of those questions, let me take a really fundamental question: why is the world intelligible? It is one of the most striking facts about the physical world that we can understand it, that it is transparent to our rational inquiry, that mathematics is the key to turn the lock of the physical universe. It is an actual technique in fundamental physics to look for theories which are economical and elegant in their mathematical expression, which, in a word, are mathematically beautiful in the expectations that it is just those theories which will prove to fit the fact. If you want to make a theoretical physicist feel uneasy you look him straight in the eyes and you say: "That new theory of yours looks rather ugly and contrived to me", and he will be very upset. Because you are saying to him that it doesn't have that character of mathematical beauty. Now when we use mathematics in that way something peculiar is happening because of the nature of mathematics.

Mathematics is the free creation of the human mind. Our pure mathematical friends sit in their studies and they dream up the beautiful patterns of pure mathematics. There is a sense in which mathematics is a pattern creating subject. And what we find is that some of the most beautiful patterns created in that way are found to actually be realised, actually to occur in the physical world around us. In other words the reason that we experience within our minds and the reason that we observe in the world around us fit together in that perfect way. Why is that so? It is not something that science explains for it is of course something that is part of the fundamental founding faith of science itself: more, I think, it is something that evolutionary biology explains. Of course there has to be some relationship between our thoughts and the world around us. If there were not we should bump into lamp-posts all the time and we would not survive very long in the struggle for existence. But I am not talking about everyday thinking and everyday experience. I am talking about very abstract mathematics, and very far from every day experience I am talking about the mathematics that is necessary for example for quantum theory or for cosmology, very abstract forms of mathematics, used to explain experience totally remote and indeed totally contrary in character to the experience of everyday living. There is something very deep-seated and significant in the way that the reason within and the reason without fit together. Not only does that seem to be so for me, but perhaps more to the point, it seemed so also to Einstein. Einstein once said: "The only incomprehensible thing about the universe is that it is comprehensible".

Now, is that just a bit of luck for those of us who happen to be good at mathematics or is it something for which we should seek an explanation? Well, my instincts as a scientist are to seek an explanation. And a satisfying explanation would be that the reason within and the reason without fit together because they have a common origin, in the rationality of the creator who is the ground of all that is. And it seems to me that the role of theology is to address these fundamental questions. I think the role of theology is to provide that most comprehensive setting in which all human knowledge and insight can find its rightful place. I really do believe that theology is the queen of the sciences - not in the sense that it tells the other branches of human knowledge what they should be doing - not at all, but that it provides the setting in which their accounts will find their completion and their integration. So that theology in its role of queen of the sciences has to listen to what the other forms of human knowledge - physical and biological science, the insights of ethics and esthetics and so on - have to say about their own domains of experience. And there is of course in Christian theology a long tradition which sees that as part of theology's role. I suppose principally the tradition that stems from St. Thomas Aquinus and in our own day the writings of Bernard Lonigan have very much taken this point of view. Lonigan, I think, presents the theological endeavour as the search for understanding through and through and I am very responsive to that. The instinct of science is to seek the most profound understanding available. And that search will in the end prove to be the search for God. Lonigan says somewhere in his book 'Insight': "God is the eternal rapture glimpsed in every Archimedean cry of eureka". I think that's a splendid thing to say.

What does this have to do with comprehension of creation? Well I think it means that we have to pay attention to the scientific insights about the way that the world actually is, and how it has developed over its history. And to do that is certainly in the spirit of some of the biblical writers. It is the wisdom writers, who exactly take that rather cool dispassionate view of the world which relates rather directly to a scientist's way of thinking. And it is fascinating that the answer to Job is to be pointed to the grandeur and the mystery of the world that God has made. It is also, I think, significant and helpful that the wisdom writers are in a sense the most ecumenical of the biblical writers, wisdom crosses cultic frontiers. So that as we all know, the book of Proverbs can take a chunk out of ancient Egyptian writings, and incorporate them in the book of Proverbs - something inconceivable in the realm of the priest and the prophet in ancient Israel.

So what we have to do, I think, is in the light of scientific knowledge - and also in the light of the insights of religious experience -, to seek an understanding of how God is working within His creation. And we need both those sources of illumination. We need the light of scientific knowledge because what we are seeking is a consonance - consonance is a very important word to me in this area, a consonance between what is assertive theologically and what is actually happening. But the insights of religious experience are also essential because of course there is no unique route from investigation of the physical world to a wider metaphysic. How we make that wider construction will depend upon other parts of our experience and insight. You've only got to think of Jacques Monod and Teilhard de Chardin both looking at the broad sweep of

evolutionary biology, and reaching such contrasting metaphysical conclusions. Well, let me get down to business, I want to try and describe to you very briefly, in the remainder of this section, the scientific world view as I see it. Now I see it of course from the point of view of a physicist. Every perspective provides certain advantages and has certain limitations. You have to bear that in mind, in what I have to say. And I want to suggest that there are for our present purposes seven features of the scientific world view that are worth taking on board, that are worth thinking about:

1. The first scientific insight about the world is a very simple one. It is that the universe is very big, and that it has a long history. We all know that our sun is just an ordinary star among a hundred thousand million stars in our galaxy - the milky way. And that the milky way is nothing much to speak about among the hundred thousand million galaxies of the observable universe. And we also know, of course, that we can trace back the history of that universe about fifteen thousand million years to the fiery explosion of the big bang - all very humbling really. And when we think of the history of the universe from the big bang to the present day, this is the main point I want to make here, it is characterised really by a transition from great simplicity to evolved complexity. Very soon after the big bang the universe is really incredibly simple. It is just a great quark soup. It is just a ball of undifferentiated energy if you like. And the reason that cosmologists are able to talk about the very early history of the universe is that the universe is very simple at that stage, that is why we can talk about it. But as the world evolves, so of course great variety sets in. Galaxies and stars condense and in our own particular planet, our own particular speck of cosmic dust, very complicated physical systems come into being. Systems so complex that in the end they are capable of sustaining self conscious life. And it is a very striking fact that the universe is so fruitful that its evolving process produces out of great simplicity great variety and complexity. That is my first thought.

2. The second one is this. When we think of the size and age of the universe, sometimes we feel a little bit daunted by it, but we shouldn't be so. The size of the universe is necessary for us to be dismayed by it. If there were not always trillions and trillions of stars, we wouldn't be here. And the reason for that is that the size of the universe is directly related to the age of the universe. And it takes a long time to evolve cosmic processes to make such complicated and interesting systems as men and women. It takes fifteen thousand million years and, therefore, the universe, the observable universe, has to be fifteen thousand million light years big. Now that insight is part of a much wider insight that science has acquired in the last twenty years which is called in the jargon 'the cosmological anthropic principle'. We have come to realize that we do not live, apparently, in any old world: that the law and circumstance, the scientifically given facts about our universe have to be very delicately balanced, that it is very hard to resist using words like very finely tuned, in order that the evolving process of the universe will produce such complex and interesting systems as you and me. Let me put it this way. Suppose the Lord were to lend you the use of his universe creating machine. As you approach this no doubt

rather impressive piece of machinery, you would find that there was a row of knobs which you could adjust in order to specify the law and circumstance of the world that you were going to create. For example there would be a knob labeled gravity. If you turn that knob up then gravity will be stronger in the world that you are going to create, if you turn it down it will be weaker. So you would set the knobs for the strength of all the fundamental forces of nature that you wanted in your world. There would be another set of knobs which would be concerned with circumstance. Things like the size of the world that you were going to create, and you would have to adjust those. Right, you adjust the knobs, you pull the handle, and out comes the universe that you have decided to create. You then wait to see what happens, and of course you have to be very patient in the cosmological business, you have to wait a few thousand million years. You wait to see what happens, and our insight, the insight of the cosmological anthropic principle, is that unless you have adjusted those knobs very close to the settings that would actually specify this universe, the world that you have created would be very dull and boring. It would not produce in its evolving history such complex and interesting systems as ourselves. If you want to have a world that is anthropically fruitful you have to have a world that is very finely tuned to look like the universe which we actually inhabit. Now that's a very interesting insight about the world: that we do not live in any old universe. I could elaborate that for atheists but I wont. It is the sort of scientific counterpart of the seven times reiterated statement in the first chapter of Genesis, that when God looked upon the world that he had made, that it was good. The second thing about the physical world is that it is not any old world, it appears to be finely tuned and particular in its circumstance in ways that make its processes actually fruitful.

3. The third insight is a very familiar one. As that process evolves, as the fruitfulness of the world is realized and comes into being, it is always through a continuous interplay of chance and necessity. It is chance - and by chance I really mean a sort of shuffling exploration of possibility, of a set of uncorrelated space - which is the origin of novelty. Atoms come together in some new configuration; a gene mutates in some new way. Without chance new things would not happen. But without lawful necessity the novelties so produced would not be sifted and preserved. And the fruitfulness of the world depends precisely upon the interplay between those two. A world simply of chance would be chaos, a world simply of necessity would be sterile. The fruitfulness of the world, the coming to be of novelty, depends upon the interplay between chance and necessity. And because of that interplay, the process of the world is not predictable, the future is open, and new things can happen. This obviously relates to a number of the things that Dr. Altner was talking about yesterday.

4. The future is open, there is genuine novelty in the world because of the fourth property to which I want to draw your attention, which is that whatever the physical world is, it is not a mechanism. The eighteenth and nineteenth century picture of the universe as a sort of gigantic beast of divinely constructed clockwork is definitely dead. It is dead partly because of the cloudy fitfulness of quantum theory, the unpredictability and unpicturability of quantum theory.

But I think that this is only a minor reason for saying that the world is not mechanical. I agree with what Professor Altner said yesterday that individual quantum events are intrinsically random, but of course when you get a lot of them it builds up regularity. That is the principle of the life insurance office. And it works in the physical world as well. But what we have come to realize again in the last twenty years, is that even within Newtonian physics, even within the reliable classical picture of the world, the world is intrinsically unpredictable, the physical process is intrinsically unpredictable. The ceaselessly revolving planets and most physical systems, even in Newtonian terms are intrinsically unpredictable.

Let me give you an example. The collision of billiard balls is a simple newtonian problem. Again we teach people how to do it. But the behaviour of billiard balls after a collision is extremely sensitive to the exact details of the collision, the exact angle of incidence for example, as anyone who plays snooker will know. If you have a system which consists of a sequence of billiard ball collisions that uncertainty will rapidly, indeed exponentially, increase. From many points of view you can think of the molecules in a gas as colliding like little billiard balls. Suppose we take an ordinary volume of gas at ordinary temperature and pressure. In ten to the minus ten seconds, that's one ten thousand millionth of a second, in ten to the minus ten seconds on average each molecule has had 50 collisions. We then ask ourselves how accurately would we have to know the motion of that molecule at the beginning in order to be able to predict what it would be doing ten to the minus ten seconds later after those 50 collisions. We put those numbers in, it comes out this way: in order to be able to know what that molecule was doing, you would have to know its original state with a sensitivity which would alter if I were to put another electron, that is the smallest particle of matter, on the other side of the universe - that is as far away as I can put it - and allow for the increased gravitational effect that is the weakest force in nature. So you see such a system of billiard ball colliding molecules is intrinsically unpredictable, and indeed intrinsically unisolatable, because exactly what it does depends on whether or not there is that extra electron on the other side of the universe. This is an example of the exquisite sensitivity of dynamic systems. Now, I have said that they are intrinsically unpredictable. That is of course an epistemological statement of what we can know. Now you can say: "Aha, but nevertheless they are totally determined". Well you can say that, but you don't have to. My instinct as a realist is to feel that epistemology and ontology, what we can know and what is the case, are closely related to each other. And I think that the natural way of interpreting the exquisite sensitivity of those systems is to believe that the newtonian determinate world picture is itself only an approximation to a more subtle form of reality. So I think we have good grounds, we are certainly able to believe, and have good grounds for believing that the world, even at the classical level, is not a mechanism, it is not an organism either, it is something in between. I don't know how to describe it, but it is not mechanical.

5. That is a very important insight to take on board in my view. Because of that subtleness, because of that sort of looseness in the world's

structure, physical process is characterised by an interlacing, a mixing of order and disorder. That is my fifth point. And if that is so, in that world of chance and necessity, of order and disorder, then of course it will be a world with ragged edges, it will neither be totally chaotic, nor will it be totally and steadily reliable. It will be a world, of course, containing genetic malformations and many blind alleys as well as much interesting novelty and fruitfulness. And that interlacing of order and disorder, can also bring about a world in which there is both law and novelty. We had a bit of a discussion about that yesterday. It is a very important insight, I think, that you can have a world which incorporates regularity, without being a world of total rigidity, in which there are reliable, indeed eternal, everlasting laws but in which the consequences of those laws have all sorts of novelties built into them which are unforseeable in advance. Let me give you an example. Suppose I take an everyday example, which if you have never seen it happen, will astonish you. I take some water and I heat it up. I put the thermometer in the water; as I apply the heat in a quite uniform way, the temperature rises. Forty, fifty, sixty, seventy, degrees. Beautiful regularity. If I had never got to a hundred degrees before I would be astounded at what happens. At that particular point, as we all know, the behaviour changes quite suddenly, quite discontinuously. The simple extrapolation that the thermometer would keep on going up fails. And so something totally unexpected happens - a phase change, the physicists say - a little bit of water turns into a lot of steam. Now the laws of physics do not change at a hundred degrees centigrade, they are exactly the same. But the consequences of the laws of physics change very remarkably. And we are very familiar with the fact that we can have underlying regular law with many different consequences.

6. And that leads me on to my sixth point about the world, that it is a world of emergent properties and genuinely new things happen as complexity increases in the world. Again the basic laws of the world don't change, but the consequences of those laws do change. Let me give you one example of an emergent property. Our experience of time. Fundamental physics does not know a direction for time. Again let me take the billiard balls. If I take a film of a billiard ball collision, and I show you the film, and I say to you is that film run backwards or forwards, you will not be able to tell me, because it will make perfect sense either way. So at the microscopic level presented by the billiard ball collision, time there is no distinction between past and future. I now take a big collection of billiard balls all moving around on a tray and I show you the picture. The picture shows: the billiard balls whizzing around banging into each other, and just as the film ends, each ball stops and they are left in a perfectly symmetrical array. And I say to you, "Was that film run backwards or forwards?" What's the answer? It is run backwards of course because we know that you can start with regular arrays, but you can't be clever enough to finish with them. Entropy runs one way. So, the direction of time, the distinction between past and future, is an emergent property of the world, not seen on the microscopic level, but perceived and experienced on a macroscopic level. Now we have to move on.

7. The seventh and final property of the universe is this: I have spoken about the fruitfulness of cosmic process, but in the end the whole physical universe is condemned to futility. On the largest possible scale, the history of the universe has been a tug of war between two opposing tendencies. One is the fiery explosion of the big bang throwing matter apart, the other is the contracted force of gravity pulling it together. And they are very evenly balanced. And we do not know which is going to win. So when I talk about the future of the universe I have to talk about two scenarios. If expansion wins, the galaxies now flying apart will fly apart for ever getting further and further from each other. Within each galaxy, gravity will win. And the galaxies will, within themselves, contract into gigantic black holes which in the end will decay by one physical process or another. So that way, the universe will decay, that is the modern version of the heat death of the universe: a pretty bleak prospect. Well, what happens if gravity wins? I am afraid that the prospect is equally bleak. If gravity wins, then the present expansion of the galaxies will one day be reversed. What began with a big bang will end in the big punch as the whole universe collapses again into a cosmic melting pot. So, the preacher was right. On the longest and largest cosmic scale in the end - "Vanity, vanity, all is vanity".

You remember that I am suggesting that science and theology do relate to each other within the unity of knowledge. Not in a sort of deductive way, but in a way which is connected with consonance trying to see how those different insights that they present relate to each other and could conceivably be descriptions of the one world of our experience. So I want to take the seven points about the physical world that I sketched and suggest very briefly related theological reflections which, at least to me, seem consonant with what science has discerned about the process of the world.

1. The first point, you remember, is that the world is very big and that it has a long history. And that seems to me to say to us that God has many purposes at work within his creation, many of which we may be unaware. We need, I believe to be delivered, not only from anthropocentrism but also from geocentrism. And I certainly don't think that the long history of the universe has been just a fifteen thousand million year long overture before the starting of the human drama here on earth. So let us raise our sights, I think that natural theology of the sort that I am trying to do has this to be said for it, that it delivers us from too great a sort of bondage to human existential concern. That concern must be there, but if that is all theology is always in danger of turning into anthropology.

2. Secondly, the insight of the cosmological anthropic principle is that we live apparently in a finely tuned universe. I think that this is encouraging to theology in that theology does not suppose that we live in any old world but that we do indeed live in a world which is intended by its creator to be fruitful. And I think that this is an illustration of the possibility of a revived and revised natural theology, a natural theology that has both been revived but which is also different in character from the classic natural theologies of the late middle ages and the eighteenth and early nineteenth centuries. It is revised because it does not point to things that

happen within the process of the world. It does not say, "Look at the hand, its marvelous aptness, that proves that it must have been designed by a designer". As we all know Charles Darwin drew the rug from underneath that particular argument. It points not to particular happenings, which is science's realm to explain. But it points to the given law and circumstance, which is science's starting point, and which is the ground of all possible process. And it says that those things themselves seem to point beyond themselves and to require some more profound explanation. So that the cosmological anthropic principle, the fruitfulness of the universe, from this point of view, finds its natural explanation in the purposes of the creator.

3. Thirdly, we thought about the familiar fact that it is the interplay of chance and necessity which produces the openness and novelty of the world's process. Now of course some people have felt that the role of chance, the unpredictability therefore of the process, the role of chance is destructive of a theological claim that there is a purpose at work in the world. And I suppose nobody has felt that more strongly than Jacques Monod in his famous book called in English "Chance and Necessity". And you remember that in that book Monod wrote with all that gallic rhetoric and, if I may say so, intensity: "Pure chance, absolutely free but blind, lies at the basis of the stupendous edifice of evolution". And of course where Monod puts in the knife - so to speak - is the word blind. For Monod, the role of chance meant that the process of the universe is really a tale told by an idiot. Well we don't have to see it that way. It is chance and necessity, it is both, it is the interplay between the two which produces fruitfulness. And I think that there is a very helpful theological way of thinking about the interplay of chance and necessity. If one may respectfully say so, the creator was faced with a dilemma in creation. On the one hand, the God of love must give freedom to his creation; for the gift of love is always the gift of freedom. The God of love can be no cosmic puppetmaster. On the other hand the God of faithfulness must also give the gift of reliability. The creation of the God of faithfulness must be drowned by the waters of chaos that the Hebrews feared so much. Now it seems to me that the dialectic of chance and necessity exactly reflects the gift of freedom and reliability to the creation by the creator who is both loving and faithful. So that the God who made the world gives it both freedom and also reliability and that God is patient and subtle a God of process - with a small 'p' - not magic. And that of course involved in creation there was a kinosis of God's omnipotence, the gift of freedom is the gift to the world - not just to humankind - but to the whole of creation, the gift to explore and realize its own character and potentiality. There is a very beautiful book written by the English theologian W.H. Vansten. The book is called <u>Love's Endeavour, Love's Expense</u> and is a meditation on the precariousness and costliness inevitable in the creation of value by love. And in that book Vansten writes this: "The activity of God in creation must be precarious, it must proceed by no assured programme. Its progress, like every progress of love, must be an angular process in which each step is a precarious step into the unknown. It is the realization of vision, but a vision which is discovered only through its own realization." Now those words are very striking, because Vansten in his book displays no knowledge really of the scientific insights into

the process of the universe. But his description seems to me a perfect fit with those processes as we discerned them. The interplay of chance and necessity in realising the fruitfulness of the world is beautifully described by saying it is the realisation of vision, but a vision which is discovered only through its own realisation.

4. My fourth point is that the world is no mere mechanism. That it has a flexibility, a suppleness within its process. That I think affords a threefold freedom. A freedom for the whole universe to be itself, a freedom for us to act within that universe of which we are part, and also I think it is reasonable to suppose that God has not only given freedom to the whole world and to humankind but also has reserved some freedom within the subtleness of process for its own action. I think we begin to perceive a world, not only of which we can see ourselves as inhabitants, but also a world which is not closed to the providential action of God, a world in which a scientist can pray with integrity. That is very brief and there is a lot to be said about that, in fact I have just finished writing another book about that, but let me leave it there for the present.

5. The fifth point about the world was that order and disorder inter-lace in its process. I think that this is helpful for what is perhaps the most central and most difficult problem of theology, which is the problem of theodicy, of understanding the problem of evil and suffering so widespread in a world asserted to be the creation of the God of love. We are familiar with the idea that the problems of moral evil can, at least, to some extent be met by a freewill defense which says that it is better for God to create freely choosing human beings than to create perfect automaton. I think that that freewill defence against moral evil needs adding to it a free process defense in relation to physical evil. That the exploration of the world's potentiality by the world is also a good thing, even though it involves genetic malfunction. The English theologian Austin Farrer thinking about the Lisbon earthquake in the eighteenth century which caused such perplexity said: "What was God's will in the Lisbon earthquake? It was his will for the behaviour of the elements of the earth's crust that they should behave in accordance with their nature". And I think that is right. It is a world with the interlacing of order and disorder in which we see progress through catastrophe. John Hicks says somewhere that "ophelix culpa" is a necessary part of any Christian theodicy.

6. Sixthly I said that the world has genuine novelty, that new qualities emerged in the course of its evolving history, that the future in that sense is open. And I think a consequence for that theology is that God does not know the future. He does not know the future, because the future is not there to be known. It is not like a traveler moving through a valley where the man in the helicopter overhead can see what is around the next corner. What is around the next corner is not yet. I think that involved in creation was not only a kinosis of God's omnipotence, but also a kinosis of God's omniscience. God knows all that can be known, but the future cannot be known. If that is right, then we will have to incorporate within theology scope for a temporal pole in God as well as an eternal pole. Not necessarily in the way that the process theologians do, I think

there are alternatives. It seems to me that G. Moltmann in his prolonged flirtation with process theology remains sufficiently detached. For me, the most helpful account of the possibility of a di-polar God is contained in the work of the English theologian Keith Ward in a book called Rational Theology and the Creativity of God. I found it a difficult book for a non-philosophical person like myself, but certainly helpful.

7. Seventhly, rational theology and the creativity of God. My final point was that the universe is condemned to futility. And I think we have to take that very seriously. That means, I think, that there is no ultimate fulfilment within its process. We are familiar with that fact for ourselves, we are condemned to decay within a time scale of tens of years. The universe is condemned to decay within a time scale of tens of thousand of millions of years. But a few noughts don't matter very much. For ourselves and for the whole world, in the end the only hope is God himself. The only true and conceivable source of lasting hope is God alone. And I think that the perceptions of modern cosmology do not encourage a sort of facile optimism within physical process alone.

Its time to come to an end. Einstein once said: "Religion without science is blind. Science without religion is lame" - a famous saying. His instinct that they need each other was right though I would not describe their separate shortcomings in quite the terms that he chose. Rather, I would say, religion without science is confined. It fails to be completely open to reality. Science without religion is incomplete, it fails to attain the deepest possible understanding. The remarkable insights that science affords us into the intelligible workings of the world cry out for an explanation more profound than that which science itself can provide. On the other hand religion, if it is to take seriously its claim, that the world is the creation of God, must be humbled enough to learn from science what that world is actually like. The dialogue between science and religion and theology can only be mutually enriching. The scientist will find in theology a unifying principle more fundamental than the grandest unified field theory of physics. The theologian will encounter in science's account of the pattern and structure of the physical world a reality which calls forth his admiration and wonder. Together they can say with the psalmist: "Oh Lord, how manifold are thy works, in wisdom thou hast made them all."

GOD, HUMANITY AND NATURE FROM AN AFRICAN PERSPECTIVE
SUMMARY

J.N.K. Mugambi

Only in philosophy can science and theology find a common ground for conceptual clarification. The validity of scientific theories ought not to be judged on the basis of theological criteria. Likewise, the consistency of religious doctrines (including the Christian doctrine of creation) ought not to be judged using the rules of empirical science, because such doctrines presuppose rather than propose world-views. Religious doctrines are normative and assessive rather than propositional. On the contrary, scientific theories are propositional rather than normative despite occasional shifts.

Specifically, the theme "Science and the Theology of Creation" is concerned with trying to discern the epistemological status of scientific theories on the one hand, and of religious (Christian) doctrines on the other. The selection of this theme is conditioned by the presupposition that there is a conflict, or at least a misunderstanding, between empirical science and the Christian doctrine of creation. This presupposition locates the theme, and the debate following from it, squarely within the western intellectual tradition in which Christian doctrine, philosophical analysis and scientific observation have often been seen as competing and conflicting epistemological approaches in the human quest to comprehend reality.

Other intellectual traditions do not presuppose such a conflict. One of the constructive objectives of exploring this theme in a cross-cultural setting might be to highlight the relative strengths and weaknesses of each tradition, and to promote complementarity rather than prejudice. In the oriental intellectual tradition, for example, philosophy is viewed as the "foundation of reason", as Immanuel Kant would say of the role of philosophic reflection in the western intellectual tradition. Rather, the role of meditation in the oriental tradition is pure 'revelation' of truth, and the goal is attained when the seeker after truth becomes fully absorbed in or integrated with the universal soul. Within that tradition, the distinction between philosophy, theology and empirical science is blurred. There is no clear distinction between science and theology because empirical science is viewed as the enhancement or facilitation of enlightenment. Thus the distinction between fact and value is not as sharp in the oriental tradition as it has been in the western intellectual tradition since the Renaissance.

The African intellectual tradition also does not presuppose a compartmentalization of knowledge into mutually exclusive categories such as religious doctrine, philosophical analysis and scientific observation. The tradition takes it for granted that reality, with all component ontological categories, is not a phenomenological accident, but a mystery explicable fully only to the One who brought it into existence and who continues to sustain it. Thus God in African epistemology is not separate from reality but an integral part of it. Transcendence of God is taken for granted to emphasize the ontological distinction between God and all other beings and things but not to imply spatial or temporal separation.

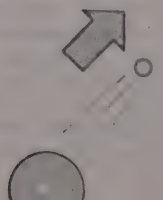
Science in such an epistemology necessarily sets the limits of the scope of its enquiry within the ontological categories which it is capable of investigating. Likewise, philosophical reflection takes this ontology to be axiomatic and then proceeds to discern the means by which reflection could facilitate further integration and reconciliation. The scientific expert cannot, in the context of traditional African epistemology, denounce religion and remain an expert, because the denial of the basic world-view implies failure of the scientist to recognize his limited role as a constructive leader of opinion in his cultural environment. Thus the traditional doctor, when he has failed to cure a disease, is willing to hand over the patient to "God", thus admitting the limitations of human knowledge and ability. In traditional African epistemology, science without faith is impossible to support, whereas it appears that in western epistemology those scientists who are religiously committed are often challenged to defend the authenticity of their scientific profession.

The implied suggestion that a scientist cannot simultaneously uphold a scientific theory and a religious doctrine apparently conflicting with that theory, is untenable in traditional African epistemology. Two scientific theories can be in conflict with one another but one religious doctrine can remain valid in the context of both those theories. Thus two traditional doctors might differ in their knowledge and skills for curing a particular disease, but when both of them fail in curing that disease they will surrender the affected patient to "God".

Whereas empirical science in the western intellectual tradition has been mainly iconoclastic (shattering cherished cultural and religious images of past and present in order to propose new theories only to be criticized by later scientists), the contrary has been the case in the African intellectual tradition. Both science and philosophy in the African tradition have been epistemologically integrative rather than divisive. Religious doctrines presuppose a world-view reinforced by science.

It is important to emphasize that this integrative relationship between stipulative (philosophical), normative (religious) and empirical (scientific) approaches to reality is not sustained merely because of a lack of sophistication and social organization.

One serious implication of this emphasis is that contemporary African scientists, philosophers and theologians may internalize and synthesize appropriate aspects of the western intellectual traditon, without necessarily abandoning the traditional African epistemological presuppositions. The outcome of such a blend is the discovery of authentically new insigts, which can contribute novel cultural and religious models for the global community of the future.



THE TECHNOLOGICAL APPROACH TO NATURE

David Pullinger

In recent years, many of our conservation bodies in Britain have put out tape, slide or video productions, and everyone of them starts with some religious image, sometimes of Adam or the story of creation, at other times of the North American Indian poem and song "I am".

Why do they all start at this point, even though they are not religious authorities? I think it is because we intuitively recognize that the earth and everything in it was here before we individually and corporately arrived. We were born into it. They also make it because of our perception that the earth is not as we believe it should be. That is the main reason why we are gathered here today. We have a common concern for what is happening. From this position we quickly learn that not everyone shares this same concern, and we become part of a conflict of concerns and of interests. This conflict arises through the exploitative and unjust handling of our resources. At the root of it is technology, the way we actually use our science, the end-product of all our labours. New conflicts often emerge for technical reasons: new forms of power generation, new ways of making vegetable oil, or an increased demand for certain chemicals and oil-based products.

How do we save this creature, this forest, this child, this earth? What should we do? We soon discover that as individuals we cannot do much, for in general our doing turns out just like everyone else's. Like Moses, who saw his fellow countrymen in bondage and under violence, our response is often to use the only means that has been taught to us. As Moses killed the Egyptian and was rejected by those he wanted to save, we begin to question how our attitudes have been formed and by whom. What we need is not knowing what to <u>do</u>, but what to <u>think</u>.

Many start to rush after leaders who claim to know the answers. Every group has always had its own answer as to how to live for God under an oppressive regime. We have seen the rise of many such groups who have done much to focus our attention on the problems. However, even in simple things like changing from using aerosols and hamburger cartons, and getting rid of chloro-fluoro-carbons to protect our ozone layers, there are already suggestions that the alternative being introduced with great fanfares actually may do increasingly more damage to lower atmospheric levels. One of the solutions to acid rain is to avoid coal burning by using nuclear power stations. All our solutions seem to end up with more problems. After a flurry of enthusiasm and activity, people become disillusioned because they recognize that technology is far more complex than they had imagined, and that the task to substantially changing something requires changing a whole set of implicit assumptions, general consensus and patterns of life style, both personal and corporate. I am telling us our own story here. Many of us who believe that this thin green and blue smear of life on this small planet is in imminent and almost irreparable danger have to admit that we do not need to be told what to do but are, in fact, in need of something else which many of us identify as a saviour. So - whether for selfish or altruistic reasons - we ask questions. How do we convince others of the need for change? How

are we going to make changes in what we do? Where in all the activity of the world for men and women of all races and ages do we begin to transform our interactions?

There can be no integrity of creation without technology. A Luddite response, that of turning our back on everything we do, is not the answer. The damage that is done to nature is mostly technological, not meaning just applied science. Technology is not simply putting into practice what we learned through science; it is literally knowing about our doing, and that doing is normally narrowed to using, affecting, or controlling the environment around us in some way.

We are not born into this creation as simple and noble savages but as technologists. We know that creation, according to the Genesis account, was not complete without human intervention as Genesis 2:5 and 2:15 suggest in Adam's work. Did Adam act in ignorance? Did humans till the ground with an absence of any thought that in tool-making there was a purpose? No, there was learning and conscious thought. Adam had seed bearing plants for food (Genesis 1:28), but not all green plants. Fruit could be eaten, but not of every tree. Adam was told he had to understand the place and interrelationship of all birds and beasts of the field. To name something in the Old Testament was to reflect its being, it was to understand its place in the complex interdependence of life, its interrelationships with other creatures and plants. Adam had to have understanding about both plants and animals; he had to be a natural scientist. Both the instruction to work the land and the knowledge demanded by God in the Genesis account suggest that conscious thought about human action was required, which means that technology is an integral part to human interaction with the world. It should not, therefore, be viewed in a purely negative way as if nature was intended to be left isolated as a stage upon which humans walk without footprints, as many interpreted Calvin's "Nature is the theatre of God's glory" to be. This is implied in many theologies of nature today in contra-distinction to theologies of creation which tend to include the human being.

What do I mean by technology in this context? I want to clarify this because it is used with so many different meanings and because it is used with different meanings in different cultures and societies. I shall use a simple definition taken from our secondary school curriculum report for England:

1. Technology is our desire to achieve some purpose or need affecting or controlling the environment, or producing artifacts usually with others in a social activity, making use of a wide variety of knowledge and skills.

These simple characteristics mark the anthropological approach which considers technology as an activity geared to making products or to changing the environment. The history of the anthropological approach to technology is a history of the theory of inventions and their effect on society. We call historical epochs very much after that kind of technological approach such as the Stone Age, the Iron Age, the Bronze Age.

2. The epistemological approach sees technology as a particular kind of knowledge, as a way of improving things; we have a history of progress when technology is viewed like that.

3. The sociological approach defines technology in terms of the way that it affects and is affected by different groups in society. This is a very modern way of looking at it and particularly emphasises the way that all societies in the world have moved towards a technological society. The effects by different groups upon each other tend to be technological.

When I talk about "technology" I refer to all three aspects, and am essentially in agreement with the definition by the Calvin Centre for Christian Scholarship. In their book Responsible Technology, they define it as follows: "In essence we can define technology as a distinct human cultural activity in which human beings exercise freedom and responsibility in response to God by forming and transforming natural creation with the aids of tools and procedures to practical ends or purposes". In practice, there is a great deal of similarity between and intermingling of technology and science. It is not possible to make a sharp distinction between them, but I want to draw a simple relationship that may help us think about science, on the one hand, and technology, on the other, to indicate the introduction and dynamic interplay between them.

If we draw just two simple circles representing science and technology, they will overlap. Science is about acquiring new knowledge, constructing new ideas, new understanding. Technology is essentially about action, changing things, doing things, making new processes, new social things including economic constraints and opportunities, a response to cultural and historical perspectives, and perhaps more. But the interplay is important because science relies on technology to do measurements and to check out its theories: We build huge cyclotrons at CERN to check out such theories. Some of this is applied science: We take principles from science and apply them. But that is not the purpose of technology. It is the specific and explicit consideration of such things as communication skills that you do not find in science.

As we exercise technology, we exercise power. This is not a general definition of power but is largely a negative one, as found in Dahrendorf's sociological definition where power is seen as ability to reduce, to limit, and to eliminate alternatives. The social action of one person or group is restricted by another person or group. Power is only to be found negatively. In fact, in Christianity and the Bible we also find it in a sense of the liberation of prisoners, and in healing. Power is the ability to increase and open alternatives for others. This is the serving sense, which Brigitte Kahl in her article in the Ecumenical Review brings out from the two different traditions in Genesis: "The subduing of nature is also one of service." God puts Adam into the Garden of Eden to serve, cultivate and keep guard. This is not as we might imagine a blind obedience of a robot who is not allowed to think but responds to precise commands, this is one of seeking to bring forth the best possible from the ground. It is in this sense that humans have been given power, not only over other humans but also over nature. We can choose to reduce diversity or eliminate alternatives to plants, living

species and habitat, or to increase the options open. Traditional crop rotation with organic feeding of the soil and periods of fallow keep the options open for the land. When land has to be fed with fertilizers in order to produce a crop, the alternatives of that land have been reduced. Where habitats are changed in such a way that species cannot live there, nor can they find other habitats, we eliminate entirely the alternatives for those living species and they become extinct. Therefore, I extend our notion of power from a negative to a positive one, and from a sociological definition to one looking at nature as well. This use of power differentiates humans from other living species and it is essential for theologies that see God as invitational rather than coercive, e.g. Jay McDaniel's thesis in the Glion Report. Without a positive view of power, invitation is meaningless. We can say the words of invitation to a prisoner locked in a cell or to oppressed people throughout the world. But only the person with power to release them can make that invitation meaningful. It is in this sense that God has power and is invitational towards us.

Is God invitational to nature in the same way? I believe so, but not directly. As God invites us, God invites nature through us. This is not suggesting that God is not integrally connected with nature. I believe God companions nature and identifies with it, but the destructive aspects of alternative uses of power, God's power actually, are through humans. To be sure, there are invitational destructive powers of God built into nature, but the control of alternatives is through humans, and in that way we have a distinctive role to play in creation.

This is problematic for us for three reasons:

1. We can never calculate all the effects of a technological act.

2. Technology is always operated within meaning structures which are not shared throughout a single society, let alone the world.

3. Nature and the human world are charecterized by change and diversity.

There are many links with every aspect of life on earth - the so-called 'web of life' - so that we cannot easily attribute causal relations to the results of our interactions with the world. That means that what we learn in one situation may not necessarily be applicable to the next situation we come to. We have to limit ourselves to a manageable number of factors or criteria and apportion them priority. This applies to all three historical phases of technology, in brief to our understanding of what it is we are trying to do, to its application and to its evaluation once we have developed it. We have to limit what we can do to understand it. But if we refuse to act until all our consequences are known we cannot act. The real question is: How blinkered are we prepared to be and how do we make and create criteria and allocate priorities to them? Handling only a few criteria can really make us blinkered. Here is an insight from chemists, read in The New Scientist:

> "Chemists who studied the atmosphere of our planet are staring into an abyss. It is called the 'ozone hole'. When compounds of chlorine made by humans started eating away the ozone layer in the stratosphere above Antartica, they did more than puncture a hole in a

shield that protects us from harmful forms of ultra-violet radiation. They also holed the steadily developing art of building models of the atmosphere. You see, none of the models predicted an ozone hole or anything like it, nor did the idea feature among anybodies".

Indeed, so unexpected was the hole that for several years, computers analyzing ozone had been systematically throwing out the readings that should have pointed to its growth. Says Bob Watson from NASA's Research Headquarters, "As to the upper atmosphere we were complacent, we thought we knew what was going on". The talk now, wherever atmospheric chemists gather, is of surprise at the unerring tendency of the natural mechanisms that run the surface layers of our planet to operate in defiance of the models we have built to mimic them.

But I do not want to suggest that we cannot know anything. We have known about the acid rain problem in Northern Europe for much longer than we have been prepared to reduce sulphur dioxide emissions. In Australia, we successfully predicted the effect on the ratio of the male to female birth rate when they altered the proportion of trace elements in petrol, and we wonder what far bigger effects it had on the living species all around, which nobody, to my knowledge, has thought about. We have come to learn that just a little bit of anti-foul paint on boats, tributal tin (TBT), changed the whole balance of sexuality of all the creatures close to every yachting harbour. Indeed, western scientists know the effects of many things so well that we build our most harmful technology in Africa, Asia or Latin America. So there is much that we do know, but we ought to know more.

The significance of anything we do is understood in a social construct of humans. We share and differ in our interpretations, but without them we do not act consciously. In fact, we would only have what we call 'animal instinct' if we did not act consciously and give things meaning. This is graphically demonstrated for some of the debates in the area of computor science which is investigating artificial intelligence. Could we build robots to decide what to do and then go and do it? The computor scientists say that we could only build such a robot if the information upon which they make their decisions has meaning and value. But how does a robot get meaning? Some of these people are drawing on practical arguments, but you can only interact with the world if you have an understanding of intent and belief of other beings and things in the world before information can make sense. Other writers are drawing on philosophers, such as Wittgenstein, who argues very coherently that our thinking is done within a framework of interaction with the world and with each other. In other words, meaning is given only in and through our interactions with the world including each other. The philosophers are beginning to argue that unless we have this messy, untidy, bloody body, we could in fact not think. Our technological knowledge cannot be separated into plan and action, but coexists in the interaction with the world within a meaning structure, which is very interesting to me in this particular environment, because this kind of philosophical inquiry that is being thrown up by technology and technologists today, in particular the computer scientists, reflects much of our theology of incarnation.

To illustrate how different meaning structures affect what we do and how we think about things, here are Robin Clark's five common meaning or

belief structures with which we interact with the world and make decisions. Let us consider some typical technical dilemmas such as: pollution, exploitation of resources, incompatibility with local cultures, alienation etc.

1. If we look at pollution, the price response says: the pollution is inevitable but worth the benefit it brings.

2. There is a whole strand of meaning within our society on which organizations are built, which is called the 'fix it response'. We often call it 'technicism', which is the way we can solve our pollution difficulties with a pollution technology. To deal with sulphurdioxide emissions, whether in East Germany or Britain, we build on sulphurdioxide removers after the process actually creates them. The stock exchange and the finance people are now saying that this is a very lucrative area to invest in.

3. The Luddite response says: Since technology always causes problems, the only way to do things is to get rid of it or to use less of it.

4. There are the alternative technologies. One must seek non-polluting technologies: instead of burning coal we could use solar power.

5. The 'radical poltical response' says that pollution has nothing to do with technical problems but is a symptom of capitalism, not of poor technology. What we have to do is to change the structures of our society.

You will instantly recognize that there are social organizations throughout the whole world that hold all those main positions. You may like sometime to look at the other categories, which Robin Clark has drawn out very helpfully. Meanings in social organizations are very important when we think about technology and applied science as part of technology. The meaning structures and their associated technology become literally enshrined into the purpose of the organization in the form of those who supply and distribute. We are part of that or those meaning structures are built into our social organizations. To ask questions about technology raises questions about the organization itself, about people's jobs, careers and life styles. This is an essential difference between science and technology. Science has debated at the core of it, raising hypotheses, presenting alternatives. Debate is at the core of science and its development but is not built into its technological applications in the same way, which is why people are very defensive and angry when we ask questions about it. It is the same position we stand in as we heard from the women's struggles, black struggles and other struggles. We share all of these because the meaning and significance of the action is tied to the social organization. We can see examples of this even within technology, e.g. changing from valves to transistors. Many of you will recall the multi-million dollar battles over that move. Or from the internal combustion engine fuelled by oil to one using bio-gas, which is perfectly possible: it was done throughout Europe during the war; from throwing out garbage to using it safely for energy production; from moving surplus food to making it available for others to eat. It is true in the UK that the only way that the three main electricity generating companies can meet their requirements at an

acceptable cost is by nuclear power. But to challenge the necessity of the demand, as Germany for example has done with their efficiency programmes, is to challenge the implicit values embedded into the idea of producing as much as is demanded. The first thing people think of is: Does it mean we will have less? And if so, does this mean voluntarily laying aside our individual alternatives? We have less alternatives, if we have less power supplied to us. We can no longer choose to use the electricity whenever and as much as we want. This literally means reducing a demand for individual power.

This leads us onto the next main feeling we have with regard to social organizations, one of alienation. Many of those who protest outside our nuclear power stations do not do so purely out of a reaction against nuclear power, but to demand a different life style, one in which people are involved in decision-making processes. This is the reason why a policy of open information by nuclear power experts does not improve the situation. Why should we trust people where we are not involved and have no participation? This is a problem because not only are the terms of office of most national governments too short for democratic participation and decision-making (there are notable exceptions), but we now recognize that national governments are geographically too small to cater to the consequences of any accidental discharge. Democracy, as the theological institute at Heidelberg (FEST) claims, is inherently limited. These same people arguing for change in life style are the ones who struggle on behalf of those who are non-participatory.

One reason why we have difficulty in dealing with technology and its actual application is because there are different interpretations of what is happening. We operate within different meaning structures. The world is characterized by change and diversity. What may be consistent with our thinking one week may not be for the next. What is done in a stable weather pattern, which almost all western civilization has developed in, may not be appropriate for this period of high change and unstable weather patterns that we are moving into at the moment. But it may be acceptable to kill one dodo to prevent ten humans from starving to death. But is it acceptable to kill the last two to do so? For those who know Charles Birch's writing on the intrinsic value and categorization of all living species, I am not sure that even our understanding of intrinsic value within Charles Birch's categories will help us with that kind of question.

The world is characterized not only by change but by diversity: diversity of habitat, land, sea, plants, living species, humans and meaning structures. In that sense every situation in which humans seek to do technology is different. What may liberate in some situations may bind in others. For example, the growing of food in the Central Plains of the United States by removing trees and using tractors to grow wheat may be appropriate there, but it certainly is not appropriate on the borders of the Sahara desert which have only a very thin layer of humus on top of sand.

I am going to take a short look at the relationships between theology, ethics and technology. We have already presented a theology of understanding God as having power and using it in an invitational way and ourselves as being distinguishable within creation in the same manner. We

have argued that human action should increase rather than decrease alternatives for all peoples and all species, even though we recognize that power increases alternatives in the short term for only some humans and not for others. But how are we going to use this theology in practical ways?

Theology is much more insistent in its demands than we would like and is much less than the coherent intellectual framework that we would prefer. The practical theologian Prof. Duncan Forester says, "Christian theology at its heart is not so much a framework or a system of thought, logical, coherent, systematic, as a form of response to Jesus Christ. In one sense the theological task is always the same, to proclaim the gospel, but the mode of fulfilment of the task is very variable. This is because theologians cannot themselves rise above the relatives, compromises and ambiguities of history and take their stand on the Olympian hights of absolute justice and truth, from where they may judge the deeds of peoples and nations. They too are sinners. They are involved in the relativities of worldly existence. They see through a glass darkly. They need to live by forgiveness. Theologians have themselves to strive and to help others as well to live responsibly and to seek peace, justice and freedom in the context in which they find themselves. They have to learn to respond flexibly and lovingly to the demands and questions of their own situations, always aware that the possibilities are limited and the best that can be expected falls far short of the perfect will of God."

Not in the doing of technology, not in theology can we rise above these complex changing situations, and this is the background to rejecting a normative, absolute rule-based ethics. We do not have the Olympian hights of theology upon which to rest our ethics. Even Aristotle said: "In ethical matters, absolute certainty is very difficult to attain." But he also went on, "We must seek as much clearness on the subject as we can."

Our subject matter does not permit much clarity. But in the rejection of rule-based ethics we have, in the twentieth century, nevertheless developed new methods of analysis, and in particular one that takes into account the dynamic change in character of reality. The ethics that I am going to point to and justify is that of contextual ethics which admits to the pluralism and interrelatedness of motives and goals. It suggests a matter of analysis in which individual situations give ethics a direction and a dynamic, but they do not determine it, because this ethics is concerned with the human significance of meaning, which gives the shape to our human action. Both the difficulties and the positive nature of contextual ethics point to a relationship theology being particularly appropriate for studying in the context of creation and nature. Page has suggested three relationships which should always be taken into account when we look at our relation with the environment. Not just the old word 'stewardship', but including within our relationships 'trusteeship' and 'companionship'.

Firstly, our relationship of steward does use the land, giving it extrinsic value, human benefit.

Secondly, the relationship of trustee looks at the intrinsic value of the environment in terms of its preservation for its own sake, for future generations. Just as great works of art, music, literature are all

preserved for future generations, why do we not preserve great works of nature? Why do we preserve paintings but not the creatures themselves, paintings of great forests, but not forests? The difficulty is that while some of the species are known to be in danger of extinction, most are unknown, not classified. Scientists believe that of the thirty million species estimated to exist, only 1.7 million have been named and described. And we are to be trustees of all of them.

And thirdly the relationship of companion that does not look at the value of land to us, whether of extrinsic or intrinsic use, but at its inherent self-worth. This is the relationship that recognizes what we share in nature and have much in common with all other species on earth, that we independently rely on food, sun and rain. That was vividly brought home in Psalm 104 which of all the psalms speaks about this question. We identify and are identified with the rest of nature. I identify with the ants that I crushed to death as I walked here. I could just as easily die if a major storm hits the aeroplane, a tree falls on the car. "By the grace of God go I" is not a selfish thankfulness but identification. Looking at companionship theologically means that we can share with many of the ecological movements which are not religion-based.

By presenting a relationship theology I am suggesting that we can no more state precisely what to do and think than we can say what we should do or think in a family row, or in a love relationship, or in fact in any relationship where there is power to close and open alternatives one for another, or where there is painful self-identification. That does not mean that there are no guidelines. Defining and naming the relationship indicates an expectancy of behaviour and response in which we learn to act appropriately. To say spouse, husband or wife means something different to saying father, or son, or daughter of God. To say companion to creation - including other humans - indicates a different form of behaviour than to say steward, trustee, or to use some of the negative terminologies like exploiter or user. We do not come to relationships completely thoughtlessly. There are things we learn from others and from the past, from thinking and reflection even if we discover that things never quite turn out the way we expect. Our contextual ethics can guide us if it is based on the context of a relational and invitational theology, which is one of the ways in which we are beginning to use contextual ethics.

Here is an example about the patenting of a human construction, of a mouse, the Harvard mouse. Many of you will know that we as a human species have created this new mouse for research by shortcuts, by genetic engineering. The question is: Is this shortcut of creation, which we could do over a very long period of time by selective breeding, part of the creation of alternatives and part of a positive use of our power over nature or not? Is the aim to produce animals with certain protein forms in their breast milk or breeding new farm animals with reduced cholesterol and fewer calories per pound of meat a good thing to do? I want to question those things under our three relationships:

Firstly, what is its purpose? In extrinsic value, as stewards, it is for us mainly to diminish some of the effects of a poor life style. The reason why we want reduced cholesterol and fewer calories is because we eat too much and the wrong things. The reason why we want certain protein

forms in breast milk in animals is so that we can develop this eventually for humans and know how to do it - to compensate for our own shortcomings of how we eat. Is this relational and invitational?

Secondly, as trustees, I want to ask about the life of the animals themselves. We know that when we selectively breed animals they often die because of incorrect balances in their bodies; this has been happening to farm animals particularly. Many have died through being transported and kept in the wrong place because they have been selectively bred. We have no guarantee that this will not happen with animals biologically or genetically engineered. Because of such selective breeding, we loose genetic variety by concentrating on only a few genetic strands. This is particularly true of pigs and cattle. We are having difficulty now when we want to help Africa and Asia with different kinds of animals in getting the right genetic variety to help them: Many varieties have already become extinct and we only have genetically developed animals appropriate to very specific habitats and situations.

Thirdly, in companionship with Harvard mice, I want to ask: Do we have the ability to identify with them? What alternatives are we offering them? What prevents us from being treated the same way by other humans whose vision and criteria are narrow to that extent?

This is one example of how we might start to look at this. I would like to explore that more fully in terms of contextual ethics. We could probably bring out something as a Church, as a body of Christians, with regard to these kinds of things. But how do we build it into all our technology? How do we build this kind of consideration in? There is no sociological analyst, no biblical commentator who has placed technology into a cultural and social activity. What happens in a society with all the current complications I have been talking about is of concern to all of us. We have a collective concern and a collective responsibility.

To fragment life and place the responsibility onto professionals cannot and does not address the ongoing analysis of and change in social structures that is needed to reflect our developing relationships. I spoke about the social organizations and how our questioning of alternatives was not built into it. If we say it is the professionals' responsibility to do these things, then the questioning and alternatives have to be built into those structures for those particular professions. But we cannot tell the professionals that they are responsible. To question all social structures generated with those meaning frameworks requires of the whole society a collective responsibility to change them. This is why Niebuhr argued in his analysis of contemporary society that there is a collective responsibility prior to any position of specific responsibility that we may have.

The Calvin Institute suggests three middle level strategies for developing a collective responsibility in general: firstly the micro level, which we might describe as the individual; secondly the social organization or middle level; and thirdly the large scale level which is the international or cultural level. They say that we should develop networks of concern, that we need to channel our concerns, discuss them and educate one another.

This is important for another reason: One of the primary roles of this is to define and maintain a language that does not reflect particular and limiting views, such as the views of those who are in charge, and of those in search of wealth. It is precisely because whole areas of technology have been linguistically colonized by the power groups that those with a concern for alternatives are made to appear tongue-tied, naive, and wanting to conserve for the sake of it. The only way we have of discussing things today often is in economic terms. We need to educate and build up a critical awareness and introduce linguistic forms.

An essential part of this is to look at the fact that the one mark of modern day technology is the wide variety of ways in which any technical problem can be solved. We have created power for ourselves in that there are many alternatives to every technical problem. One way to build on this is perhaps educationally, e.g. by identifying the criteria which restrict those alternatives for all the different meaning structures within our society. At an international level, in the Assisi declarations in 1986 by the World Wildlife Fund we are dealing exactly with this network concern.

It is through mass media that the technological view of nature is maintained, and they called for a reform of this. It is there that the specialists give their views, where we are limited in presenting the complex interrelatedness of the problems. The first is "renewed life styles". Relational theology demands a flexible, dynamic view that mass media will not allow because they have to characterize and simplify.

I will end with a word about renewed life style. In renewed life style we need to adopt an interdisciplinary approach, expecting a pluralistic culture. We need to be interdisciplinary not because we cannot see all the ramifications of our actions but because no individual, no group themselves can encompass the totality. We need as many people as possible contributing to our understanding. Robert Lee has expressed the need in this respect for civilizing conflict. Civilization is not marked by what we do, but by the way we approach our conflict situations. The fact that we can face each other with our differences and aim for a just social organization, that is civilization. But we do not have that opportunity in most places now, and that means that we ourselves have to be prepared to change when we go into those situations. That is what interdisciplinary means. It means that we may start and end with different goals and values in knowledge. We cannot with all these range of motives end up with a consensus. It is a fool's paradise to believe that we will all agree on what to do. That is not the way for the future. But in the process of that dialogue we will change each other. The fact that we do not have a consensus does not mean that we cannot act. In fact, this is the purpose of the lay committees. As Raymond Fung's Evangelism brief points out, we can work with others with different motives and different goals, if we are prepared to face them and to change ourselves. As the Glion Report put it: Unless there is respect for the freedom of all peoples to be themselves, there is unlikely to be respect for the freedom of all creatures and nature to be themselves. The invitational life is one of integrity. We too are invitational to others.

RECOMMENDATIONS FOR STUDY AND ACTION

RECOMMENDATION

1. CHRISTIANS NEED TO CONSIDER HOW TO INFLUENCE INDUSTRY AND TECHNOLOGY IN THEIR COUNTRIES SO THAT: (a) THEY ARE MOTIVATED MORE BY HUMANE CONSIDERATIONS THAN BY THE QUEST FOR PROFIT AND POWER AND (b) TECHNOLOGY IS APPROPRIATE TO HUMAN NEEDS.

BACKGROUND

The driving forces for most technological research today are profit and power. Although it is a clear condition of this system that we have always to produce more than is needed, the extent of profit made has to have limits and it should not be accepted as efficient to cause pollution or allow hazardous working conditions. The cost of environmental care must be part of every industrial budget. At present technological inventions and innovations tend to be considered acceptable, provided that they are likely to yield more profit or greater power (military or otherwise). In the pursuit of these goals there is a tendency to disregard the ecological and ethical consequences: resources are depleted at accelerated rates, people are dispossessed of their land, the environment is polluted, working conditions are sometimes hazardous, women and children are sometimes overworked with risks to their health and that of their offspring. Efficiency is often emphasized for the maximization of profit and power, but sometimes over-efficiency becomes counterproductive and dehumanizing.

RECOMMENDATION

2. SCIENCE MUST BE ACCESSIBLE TO ALL.

BACKGROUND

Historically the sciences have understood themselves as contributing to the progress and well-being of this planet. In order to realize this aim, science must be accessible to all. It is vital to have a wide range of participation in the process of decision-making in science and technology, particularly in the assessment of the kinds of research in science and technology to be undertaken. We need to ask what are the priorities in the world and how can science help us in realizing these priorities.

1. At CERN, the European laboratory for Particle Physics costing SFr. 800 million per year, decisions on research and experiments are made only by scientists and government administrators.

2. In India there are experiments with test-tube babies, while at the same time the health services are neglecting the majority of people in the rural areas.

From a Christian perspective it is God's mandate to be especially concerned with those at the margins of world society. It is particularly important because there are many who have been made marginal by science

and technology. This raises a basic question for society and the sciences: for whom science ought to exist? It is our view that science should serve the whole of society. Science must be made open at two levels:

(i) Effort must be made to involve those pushed to the side in decisions about science.

(ii) Professional scientists must listen to the needs of the people and be available for questions on their activities, and not retreat into sophisticated language.

1. Technical language must be simplified and technical understanding should be supported by technical education for all. There are science shops in the Netherlands which attempt to make scientific research accessible to a wider public.

2. In the USA in certain places, specialists and non-specialists review applications for research and experimentation in medical, genetic and other related fields (called Institutional Review Boards). (Not National Policy.)

Sometimes expensive research projects divert resources from social services. The human capacity for curiosity and inventiveness in this case leads to the production of knowledge simply for the sake of knowledge, science becoming an end in itself and wasting finances and resources that could be used in a better way for the benefit of all. Hence there is an ethical dimension to all research which theology can shed light on.

In order to promote the dignity of life and the welfare of all creation, it is necessary for everyone, especially those most affected, to be actively involved in all decision-making processes and economic power structures of society including science. Everyone is responsible for their actions according to the measure of their power, knowledge and abilities, as in the Parable of the Talents.

Those who deny this by racism, discrimination within society or social injustice are the ones who must justify their position.

In the end, the ultimate criteria is that theology and science must work in such a way that the loving and personal God of the Bible is glorified. Science and theology should promote the dignity of life and the welfare of all creation.

RECOMMENDATION

3. BOTH SCIENCE AND THEOLOGY MUST ENCOURAGE THE PARTICIPATION OF WOMEN AND THOSE FROM NON-WESTERN TRADITIONS.

BACKGROUND

Creation: can be seen as the whole universe taken as a living organism which God has called into life. It is unfolding. The future must be open to it.

The aims of science and theology should be to promote the dignity of life and the welfare of all creation.

Science: Science is a God-given gift which increases human knowledge, capability and power within creation. Science contributes to both the reintegration and the disintegration of creation. Science has come from a male, Western rational context and that context has become a part of its ideology. It must now take positive steps to encourage the participation of women and people from other traditions in order not to promote a predominantly male, Western and rational perspective. Science should not endanger or make impossible the world's future existence.

Examples: the destruction of genetic diversity, destruction of the ozone layer, radioactive waste, releasing harmful bacteria into the environment.

Theology: The task of theology is to look for God's purpose in creation. It is concerned with renewing relationships between Creator, created and within creation, and contributes to both the reintegration and the disintegration of creation. Traditional theology has come from a male, Western perspective and that context has become a part of its ideology. Theology must now take positive steps to encourage the participation of women and people from other traditions in order not to promote a predominantly male, culturally one-sided and rational perspective. Theology speaks of the limitations, of the sinful nature and of the necessity of salvation of all creation.

Examples: apartheid, which was theologically justified; misuse of natural resources justified by seeing humanity as the 'crown of creation'.

Science and theology must always be aware of their limitations and must respect each other if they are not to take wrong directions. They do not have value in themselves but in their service and honour of God and all creation. Neither science nor theology nor any other perspective can be in a position to give indisputable answers to all questions.

Examples: repairing the ozone layer, the origin of evil, interpretation of art and music, pursuit of power.

For the discussion between theologians, and scientists who are non-Christian, it is necessary to find an ethical platform acceptable to both.

RECOMMENDATION

4. THE CHURCH CANNOT LEAVE THE QUEST FOR THE UNITY OF TRUTH EXCLUSIVELY TO SCIENCE.

BACKGROUND

Social organizations and cultural achievements are based on a variety of world views and value systems. Since the European Renaissance in the sixteenth century, there has been a dichotomy between theology and empirical science, and this dichotomy has led to divergence of views with regard to the relationship between God, nature and humankind. From the perspective of theology, God is the creator of the universe and

everything therein. From the perspective of science, nature is viewed as a continuum from simple to complex forms of matter without a special consideration for human beings as a species. The unity of truth in theology and science acknowledges the truth being uncovered by science and the coherence this truth gives to the universe created by God.

The debate between theology and empirical science is accorded a variety of emphases in different national, ecclesiastical, cultural and professional contexts. In some countries it is a significant issue, whereas in others it is not. Some churches are attaching great importance to the debate, whereas others are not aware of the issue.

The view is often held that science and theology are dealing with two entirely different aspects of reality which do not overlap. This view does not permit enough interaction between the two. It is suggested here that the ultimate purpose of any intellectual quest is KNOWLEDGE OF TRUTH which reveals God's glory. Knowledge in theology and knowledge in science must ultimately achieve this purpose of revealing the glory of God by interacting and helping each other in the pursuit. For example, we often talk about the evils of science. But in fact scientific knowledge is neither evil nor good. Rather, this knowledge in science can lead to a glorification of God by the correct and balanced use of it. Here theology can offer guidance in the use of scientific knowledge. In other words, knowledge in theology and knowledge in science have to work together if God is to be glorified, which is the ultimate goal of all knowledge. In this sense, theology and science are complementary and not competitive. However, the interaction of the two may tend to correct each other, and this relationship is often wrongly viewed as a conflict or competition. For example, the theory of the survival of the fittest was accepted as a good scientific theory. But accepting this theory at the cultural level leads to exploitation, marginalization and even annihilation of the weaker sections of the population. Social darwinism will not glorify God.

Both science and theology need to be more aware of their viewpoints (e.g. relativity in physics) and the implications of these viewpoints. They also must not loose sight of the ultimate reality beyond their theories and dogmas, never forgetting that these are simply maps made by humans but not the real world to which the maps refer.

Similarly today, issues like bio-engineering and exploitation of nature to the detriment of species including mankind need to be guided by theological perspectives. But the ultimate criterion is that in the end theology and science must work in such a way that the loving and personal God of the Bible is glorified. Slowly it dawns on the consciousness that all of us are fellow passengers embarked on the voyage towards ultimate truth and that there are risks we all share.

Cross Reference

The concept of truth in the introduction paper by Dr. A. Geense and the paper by Dr Polkinghorne.

RECOMMENDATION

5. SCIENTISTS MUST BE MADE AWARE OF THEIR RESPONSIBILITIES TO SOCIETY.

BACKGROUND-

At the final plenary session of the seminar all the participants unanimously endorsed a concept put forward by one of them. The science students of today will be the scientists of tomorrow, and there must be some way in which they could be made more aware of the tremendous ethical responsibilities they will have in their fields. It was pointed out in the general discussion that some professional groups have codes of ethics, such as the medical profession which has the Hypocratic Oath.

Could not all the students embarking on a career in science be faced with the need to see honestly the tremendous issues raised by modern science? One way would be for universities and technical colleges to ask science students to refrain from all types of research which could irreversibly affect humanity and the natural environment. This request could be made at the time they are writing their examinations. It was further noted that the current president of the Council of Ministers of Norway, Ms Gro Brundtland, might be a logical person to bring such a concept before the United Nations, given her past record of sympathy and action in this sphere.

The Seminar noted a sampling of these difficult situations facing scientists and the public, mainly referring to biology and ecology.

Biology has advanced to such a level that it is now possible through the manipulation of genes (genetic engineering) to experimentally produce new (artificial) species. This achievement has serious theological and ethical impliations. On the one hand, it confirms the capability of human beings to "dominate" nature. On the other hand, however, this achievement may intervene in the natural processes to the extent that the future will be seriously threatened. From a theological perspective, is it permissible for human beings to so interfere with natural processes as to completely alter the biosphere? As fellow creatures, what right do human beings have to alter the genetic structure of other species even where it benefits human welfare in the short term?

In ecology many examples can be cited in every country to illustrate how technology is adversely affecting the natural environment, thus threatening the lives of the people whom it is intended to serve. Dams are constructed to provide water reservoirs for irrigation and electricity, yet at the same time people have to be resettled and the local climate is altered. Forests are cleared for cultivation and timber, yet the ground cover is destroyed and water catchment areas are reduced. Factories are constructed to produce goods to make life more comfortable or for enlarging the market capacity by mass production but meanwhile the environment is polluted and the natural resources are depleted.

Other comments made in this area were the increasing waste of forests to produce unnecessary packaging and publications of dubious value, and the replanting of forests using species which are fast growing but raise havoc with the environment because they are not native to the areas (e.g. in Scotland). The destruction of tropical rain forests was especially noted.

RECOMMENDATION

6. BIBLICAL THEOLOGY SHOULD NOT BE MISUSED TO SUPPORT THE DOMINATION OF NATURE.

BACKGROUND

The people of biblical faith have understood themselves to be created in God's image and likeness. This biblical insight has often been misused in order to support an anthropocentrism (human centredness), a domination of nature by humans which has degraded nature as an object of exploitation. There is a growing awareness that the "image of God" must be understood in a more complete way. For Christians the decisive presence of God in Christ provides the essential model for understanding our role in creation (see especially Philippians 2:4-11). This self-emptying of God in the path that culminated in the cross releases us from the selfish domination of nature and accumulation of power. From Christ's example we can learn that limitations and restrictions are nothing to be feared (Mark 8:34-37). On the contrary we can gain a good understanding of being human living at peace with ourselves and the whole of creation.

CONCLUSION -- OUR CONCERN FOR THE FUTURE

In order to cooperate with God we must work with members of the Body of Christ. We are called to live both locally and with consideration for the whole world. There are many levels of community in which we participate; similarly there is a variety of paths each requiring different action. It is crucial that we join together by forming networks of relationship for the purpose of establishing communication, mutual support, nurture and solidarity.

Real justice, real peace, and real respect for creation comes from love for God and love for others.

The earth is the Lord's. We do not own it. Contrary to Capitalism, individuals do not own it. Contrary to Socialism, even societies do not own it. All of us humans are called to repent for our misuse of God's world. We need faith, love, and hope to sustain our quests for justice, peace, integrity of creation.

Questions For Study

(with Biblical references)

1. Is it permissible for human beings to interfere with natural processes so much that the biosphere is completely altered?

2. What right do human beings have to alter the genetic structure of other species, their fellow creatures, even if it seems to benefit human welfare?

3. What are the priorities in the world and how can science help us in realizing them?

4. Should science serve itself or the whole of society? What action can we take to make science more accessible? How can people take part in the power structures of science?
   (Job 98, Isa. 10:1-4; 11:1-9).

5. What is our role in creation?
   (Phil. 2:4-11, Matt. 25:14-30, Parable of the Talents)

6. Can we accept our call to work with God in creation (in reconciling and making new our "groaning creation")?
   (Rom. 8:12-13, Phil. 2:12-13, John 1:1-18, Gen. 1, Ps 8).

7. How can we cooperate to give shape to our concerns?
   (I Cor. 12, Luke 22:32).

8. Does our limited knowledge hide the reality of God's love?
   (I Cor. 13).

9. How can we find common platforms for discussions between Christian and non-Christian scientists?

10. Do the Churches look more at their dogmas than they look at the Truth?

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